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INVENTION AND THE MASSES.

In the early days of invention the progress and utilization of labor-saving machinery were hindered materially by the violent obstruction of ignorant and prejudiced workmen who fancied they saw in the introduction of the new inventions the loss of their means of livelihood. The most conspicuous example of this was in the early development of the textile industry in Great Britain. The inventions of Arkwright and Hargreaves, and of their innumerable successors, instead of throwing out of employment a few hundreds or thousands of Lancashire and Scottish weavers, paved the way to the establishment of one of the greatest manufacturing industries of the world and created employment for millions of people at better pay and under better conditions than ever fell to the lot of the craftsmen of 200 years ago.

From the eighteenth century to this year of grace 1910, is a long step, and the development of invention and history, and the education of the masses, can only be partially told by numerous historians in many bulky volumes. If one were to ask the question, "Does partisanship still coexist hand in hand with ignorance, prejudice and bigotry in the ranks of the industrial world?" the answer probably would be an unqualified "No," as emphatic as it could be made. And yet in the greatest city of this greatest republic there exists at the present time a situation which is comparable only with the events which took place in the eighteenth century, alluded to above.

The New York Edison Company is the center of the controversy. It is reported from the great commercial metropolis that upward of 70,000 customers of the lighting company, whose bills for current average less than $2,000 a year, have joined a movement to ask the legislature to compel a uniform rate for power. In this connection the New York *World* says: "These customers, known as the 'small fry,' are receiving the unanimous support of the International Union of Steam Engineers, who see in the attempt of the Edison Company to crowd out independent plants a step which will throw thousands of the Union's members out of employment."

Really, the steam engineers ought to know better. Perhaps their leaders do. That a few of these leaders will stop the development of electrical distribution from great cen-

tralized plants for any length of time is as probable as was the success of a few rioters against the introduction of Arkwright's inventions. But it is a mistake to suppose that the steam engineers will lose their means of earning a decent living. Instead there will be more employment for more men at better pay and under better conditions. Perhaps there will be a few cases of individual hardship, but on the whole the vast majority of workmen will greatly benefit in the long run, as will also the people who are now clamoring for reduced rates. And some of these very customers who now want service as cheap as the big concerns, are receiving a cheaper rate, all things considered, than they are really entitled to, and the New York Edison Company will have not the slightest difficulty in proving this should a test case ever come up before the courts.

ACCOMMODATION IN STREET CARS.

The city of Syracuse, N. Y., is having a popular agitation for a no-seat-no-fare ordinance, similar to that already in force in Trenton and Jersey City, N. J., apparently in spite or in ignorance of the fact that the measures adopted in these New Jersey towns to compel the street-car companies to provide each passenger with a seat are admittedly meeting with little or no success.

In Europe such laws are in force and, *mirabile dictu*, are generally enforced. In Liverpool and London, for example, no one can ride on a public street conveyance unless there is a vacant seat available, and if there is no accommodation one has to choose between waiting for another car, and walking. But then conditions in Europe are different from what they are here. On the other side of the Atlantic, people are seldom in a hurry or at least they have a way of keeping it to themselves if they are, whereas in America the reverse is usually the case. Again, the temper or temperament of Americans is different from that of a European crowd, within certain limits. Both are long-suffering, but in a different way. Hence it would appear that any no-seat-no-fare ordinance in America is doomed to failure. The only redress is to remove local congestion as far as possible, and apply the first-come-first-served principle in the rush hours.

It must be remembered that a street-car company supplying fair accommodation at a fair price cannot afford to provide a large amount of extra rolling stock for rush-hour use only, for this equipment would be earning no revenue at all during the rest of the twenty-four hours. And then again it happens in many cases that there is no extra trackage in the heart of a congested city to handle this increased vehicular traffic, especially in such cities as Brooklyn.

The American system of universal fares has been unsuccessful in Europe, and on the other hand the European methods of government and regulation are usually not applicable in this country.

ECONOMICS OF THE SMOKE PROBLEM.

The substitution of electric power for steam power is a potent argument for the smoke abolitionist, but to make it truly effective the central stations themselves must lead the way in this laudable endeavor and render themselves immune from criticism with regard to the emission of visible smoke from their stacks.

Smoke and inefficiency are correlative items in the operation of a central station. A well-designed and perfectly operated boiler will not emit smoke. If a boiler does smoke, it is due to faulty design, unsuitable fuel, unskillful firing, or overloading. Correct these evils and there will be no smoke. Smoke-consuming devices are all right in their way, but at best their effect is but palliative and not remedial. While they reduce smoke under certain conditions they are not a panacea for all the ills of a boiler, and in certain cases, as in palpable overloading of the boilers, they are not even effective. Furthermore, the efficiency of the boiler is certainly not increased by their use, and in many cases this is one of the most serious aspects of the situation.

It is certainly high time that every central station which has hitherto been an offender against the smoke ordinances should begin to make a thorough house-cleaning. In some cases nothing less than a complete renewal of the boiler-house equipment will be necessary. In other cases a general overhaul will be sufficient. And in all cases is it advisable to keep a continuous check on the management and operation of the boilers.

The experience of the Springfield, Mass., street-railway company is instructive in this connection. This company has long been troubled with the smoke nuisance at its Margaret Street station and its progressive managers determined on a thorough investigation. The cause was soon found,—overloading of the boilers. The constantly increasing load had simply caused the company to outgrow its boiler equipment. It was found that in this case smoke-consuming devices were of no avail. A complete remodeling of the plant, calling for an expenditure of $60,000, was necessary, and this, it is reported, will be proceeded with at once. There is no doubt but that the increased economy that will result from the improvements contemplated will soon pay for the large capital outlay involved, and besides saving materially on the coal bill the company will be exempt from public agitation on the smoke nuisance as well as being rendered immune from prosecution under the city's smoke ordinance.

Another instance is that of the Lancashire Electric Power Company. In this case the expenditure of the comparatively small sum of $15,000 on the power house has increased the efficiency materially and has reduced the coal consumption twenty per cent to the fine figure of 3.35 pounds of coal per kilowatt-hour produced.—It pays occasionally to clean house.

THE TAILOR'S IRON.

Once in a while, in going the rounds of the various local sartorial establishments in a laudable endeavor to keep abreast of the prevailing styles, one finds a tailor who is using a gas-heated iron. For instance, in a centrally located place not far away from these editorial offices, there is a tailor who occupies a basement store. This man lights his premises by electricity, but uses a large internally heated gas iron (technically known as a goose) and a smaller iron which he heats on a gas stove. It is worthy of notice also that he ventilates his shop by an electric fan.

Now the loss of revenue to the local electric company occasioned by the use of these gas irons is inconsiderable, but the tailor is setting a bad example. His shop is visited daily by many of the electric company's customers, and the effect of those gas irons on a prospective purchaser of an electric iron for use in his household is extremely detrimental.

The probable reason that this man is using the gas irons is the one advanced by all unprogressive business people in a like situation,—he already has the gas irons and he does not care to go to the expense of buying electric irons when he can "get along" with his present equipment.

If he were a private person and not in a semipublic position the thing would not be so bad. It is the duty of all central-station solicitors to be on the watch for this kind of thing and to remove the setback to their business as soon as possible. Properly presented, and, if necessary, with inducements suitable to the case in point, there will be no difficulty in making a convert of such a man, thus transforming a detrimental influence into an effective advertisement.

THE PASSING OF THE BILLBOARD.

While there is a great deal of truth in the old adage anent a dog and a bad name, yet there is every indication that we Americans are living down out international reputation as an inartistic and unesthetic people. And we are going about it in a manner worthy of our progessive achievements in other and more utilitarian fields of endeavor.

One of the principal things that jars the artistic sensibilities of the foreign visitor in this country is the prevalence of that usually hideous advertising device, the billboard. Much of the architectural effect of our finest buildings is lost by this modern disfigurement, and the natural beauty of the landscapes visible through the windows of our railroad cars is marred by the promiscuous efforts of the ubiquitous sign painter. It is therefore a cause for congratulation when the missionary effort to remove these eyesores is made not by a member of the long-suffering public but by the party that profits directly from the renting of space for the exhibition of the advertising placards.

The Illinois Central Railroad, spurred on by a suit instituted by one of its stockholders to test the right of the company to let its property for advertising purposes, has decided to discontinue this practice. Now the movement is started it is to be hoped that the other railroads will follow in this laudable endeavor.

An added incentive to this movement is the growing popularity and undoubted efficacy of other forms of advertising, chief of which is the electric sign. The use of the electric sign is beneficial from all points of view. It does not disfigure the view. It increases the attractiveness of a city at night. It is many times more obvious than the printed billboard or the painted sign, and its value as an advertising medium is correspondingly greater. Furthermore, it increases the illumination effect and brings out the crowds. The electric sign solicitor will no doubt find the campaign against the billboard a decided help in the sale of his commodity.

ELECTRIC POWER IN GAS PLANTS.

Among the later applications of electric power to secure economical production, the use of motors in illuminating-gas plants is attracting much attention. About a year ago reference was made in these columns to the successful installation at Worcester, Mass., which has since been followed by satisfactory service from motor-driven gas plants elsewhere. This is a desirable kind of central-station business, on account of its long-hour characteristics and also because of the large connected load it affords. Although it may look a bit like "carrying coals to Newcastle" to attempt to sell electric power to a gas company, it ought to be possible to do it in cases where the annoyance of maintaining a separate electric generating installation is given its full weight. In many cases the gas and electric properties are under the same management, and the great benefits of gas-house electrification can be secured with little difficulty.

Experience at the Worcester plant shows that only about one-fourth the force necessary under the old hand régime is now required in the charging room. The yield of gas per pound of fuel is twenty per cent greater than with hand charging of the retorts. The quality of the fire is also improved by machine methods. At every point in its journey the fuel used in the plant is handled by electric power, and even the coke obtained from the retorts is carried away by an electrically driven conveyor. In the old days three more men were required to handle the coke, and in the retort house proper there were fifteen against a present force of four. Electrically driven blowers, crushers, weighing apparatus, telphers and cranes add to the flexibility of the installation. Steam power is notoriously inefficient for work about a large plant of this kind, where the demands upon the system are scattered and variable. On the premises some fifty electric motors are in regular use as labor-saving equipment. There is no reason why these economies should not be duplicated elsewhere.

Colorado Electric Light, Power and Railway Association Programme.

The eighth annual convention of the Colorado Electric Light, Power and Railway Association will be held at Hotel Colorado, Glenwood Springs, on September 21, 22 and 23.

The programme has been completed and all but one of the papers are in the printer's hands. The following is a list of papers:

"Storage Batteries in Street Railway and Central Station Work," by F. A. Warfield, general manager, the Colorado Railway, Light and Power Company, Trinidad, Colo.

"Some Observations on Cultivating Friendly Relations with the Public," by J. M. Connelly, the Denver Gas and Electric Company, Denver, Colo.

"Mazda Street Series Lighting," by R. L. Jones, engineer, General Electric Company, Denver, Colo.

"High and Low-Tension Pole Lines," by J. C. Lawler, formerly electrical engineer for the Colorado Springs Electric Company, but now of New York.

"The Place of Rotary Condensers and Induction Generators in Transmission Systems," by H. L. Aller, engineer, General Electric Company, Denver, Colo.

"Creosote Treatment of our Native Lodge-Pole Pine Poles," by George R. Ogier, of the Ogier, Silsbee & Ogier Creosoting Works.

The committees on "Grounded Secondaries," "Insurance" and "Meters" have interesting reports to make, and the following papers will be presented by members well qualified to handle the different subjects:

"Attitude which Central Stations Should Maintain Towards Their Customers."

"High and Low-Pressure Turbines."

Pittsburg Sues Traction Company.

The City of Pittsburg recently served notice that it will institute immediately no less than 100 suits against the Pittsburg Street Railways Company to compel it to observe the new ordinance prohibiting the overcrowding of cars. A fine of $10,000 is possible if the city wins.

New Commonwealth Edison Plant.

The new $1,500,000 power station of the Commonwealth Edison Company of Chicago will be built by Holabird & Roche, architects. The engineering work is to be in the hands of Sargent & Lundy.

Programme of Meeting of Western Association of Electrical Inspectors.

The sixth annual meeting of the Western Association of Electrical Inspectors will be held at the Rome Hotel, Omaha, on October 11, 12 and 13.

The first day will be devoted to a business meeting, with reports of committees, and in the evening the members will be guests of the Omaha Electrical Club at dinner.

On Wednesday there will be papers by Lewis G. Martin on "Rubber-Covered Wire," by A. S. Rogers on "The Influence of Electrical Inspection on the Operation of the Telephone System," by T. J. Byrnes on "Packing-House Wiring," and by John A. Rhine on "The Legal and Ethical Responsibility of the Electrical Inspector." There will also be an address on "The Tungsten Lamp," the speaker to be announced later. In the evening there will be an informal discussion on "Difficulty Arising in Electrical Inspection Work."

On Thursday there will be further reports of committees and the election of officers.

During the meetings there will be tours of inspection to the electric light and street railway power houses, the Union Pacific Shops, the Fort Omaha Wireless Telegraph Experiment Station, the Fort Omaha Dirigible Balloon Experiment Station and one or two modern theaters.

Franchise Renewal in Toledo.

One of the greatest obstacles in the way of the granting a new franchise by the city of Toledo, Ohio, to the Toledo Railways and Light Company, was recently removed when an agreement was entered into for the immediate settlement of all unpaid paving taxes owed by the company to the city. These arrearages amounted to many thousands of dollars. Negotiations have been under way for several weeks and several of the city officials expressed themselves as unwilling to discuss franchise questions until the slate was wiped of old indebtedness.

The discussion became so warm that the city had determined to go into the courts in an effort to revoke even present franchises unless an adjustment was made. After numerous conferences an amicable settlement was reached, whereby the city advances a large amount of money in payment of light bills due and those to become due to the company, the entire sum to be applied upon paving indebtedness of the company, and the wiping out of an old balance of about $89,000 previously due.

As this has been one of the chief obstacles in the way of progress in the granting of new franchises, it is probable that better headway may be made from now on, although it is difficult to see how an agreement can be reached on the terms of the grant, as the city will insist upon three-cent fares, which the company declares impossible. H.

Cosmopolitan Electric Company Buys Loop Plant.

The Cosmopolitan Electric Company, Chicago, Ill., has purchased the power plant of the Weber department store, located at Clark and Van Buren streets, Chicago, and will operate it in the future as a subsidiary of the former company.

The Weber plant, in addition to supplying the store load, furnishes current to tenants in the neighboring territory. In the last report of the city electrician this plant was recorded as having a connected load of 3,450 incandescent lamps, sixty-seven arc lamps and 181 horsepower in motors.

McAdoo Tunnels Progress.

According to a recent statement made by William G. McAdoo, president of the Hudson & Manhattan Railroad Company, work is going forward very rapidly on the Hudson River tunnels.

It is expected that the Thirty-third Street terminal station will be completed and opened about November 1, and the Twenty-eighth Street station will probably be completed at the same time. The extension to Forty-second Street and connection with the train levels of the new Grand Central Station should be completed well within the three-year limit.

Pure Radium Obtained.

It has recently been announced by Mme. Curie that she has succeeded in isolating pure radium. Hitherto it has been obtained only in the form of salts. The radium is a white metal, and oxidizes upon exposure to air or water. It was obtained by an electrolytic process from a decigram of radium bromide in the form of amalgam, which was then distilled. Professor De Bierne assisted in the work.

Walter H. Whiteside.

Along about six years ago there appeared in the pages of this journal a statement somewhat along the following lines: "The management of the Allis-Chalmers Company is drawing to itself a group of the ablest men in their representative lines in the country. The latest acquisition is Walter H. Whiteside, etc., etc." That was a momentous occasion for Mr. Whiteside, to say nothing of the effect it has had upon the fortunes of the Allis-Chalmers Company. The task before this man was one that might have dismayed any but the most rugged, optimistic and heartful of fighting men. He had not only to become familiar with all the intricacies of this company's varied products, and they cover a very comprehensive area of human activity, but new and old interests were being consolidated, sales organizations were to be enlarged, and efficiencies had to be enhanced.

Mr. Whiteside not only took the job where it started, but he developed it and he has grown with it. One of the most brilliant and energetic of the young men in the field at the time of his adhesion to this organization, he is today the exemplification of masterfulness such as we are wont to point out as the type which is responsible for the industrial supremacy of this great country of ours.

Mr. Whiteside's first business connection dates back to 1881, when he entered the employment of the Hercules Powder Company, the high explosive or dynamite branch of the DuPont Powder Company, of Wilmington, Del. He introduced its highly explosive products into the Lake Superior regions, including the Calumet & Hecla Mines as well as into other mining districts. Four years later he became associated with the Cleveland Electrical Manufacturing Company, of Cleveland, O. He remained with that concern nearly twelve years, serving the first two years in various capacities, and for the remainder of the time being manager of its Chicago office. In 1896 Mr. Whiteside was appointed manager of engine sales for the Gates Iron Works of Chicago. In 1898 the Westinghouse Electric and Manufacturing Company made him manager of its Washington office. In that position he became associated with the largest electrical projects undertaken not only in the district covered by his office but in other places farther afield. His engineering work in connection with the installation of power in the dry docks of the Navy Department, especially the docks at Portsmouth, League Island and Boston, have been widely recognized, and to him is largely due the credit for effecting the change in voltage standardization from eighty to 125 volts in the electric lighting and power installations on board the vessels of the United States Navy.

WALTER H. WHITESIDE,
President of the Allis-Chalmers Company.

It was in building up an immensely successful branch of the Westinghouse Company's business known as the Retail and Supply Department, that Mr. Whiteside did important commercial work. This work won him recognition for marked executive ability. He was soon appointed general manager of the Sawyer-Man Electric Company of New York, practically doubling his duties, for he continued the management of the Retail and Supply Department of the parent company at Pittsburg. His great ability naturally attracted the attention of the leaders in competing lines, and in July, 1904, Mr. Whiteside joined the Allis-Chalmers Company, accepting the position of general manager of sales. The latter company had just taken over the Bullock Electric Manufacturing Company, and the selection of Mr. Whiteside was in response to the necessity for a vigorous, clear-headed personality, that would bring into harmony the divers interests which were of necessity existing due to the merging of several classifications of manufacture.

Mr. Whiteside's success with the Allis-Chalmers organization was so conspicuous that very soon he was loaded with responsibilities of an executive nature, and for nearly a year was in full charge of the operations of the organization with the title of vice-president and general manager before he was elected president of the Allis-Chalmers Company.

From what has already been said it may be suspected that Mr. Whiteside is a man of great force of character. He is this and more. He thinks on his feet, and he appears always ready with a quick solution of the most intricate problem. He is a forceful speaker and keeps his word whether he merely speaks it or puts it in contract form. He is beyond all this a delightful personality, and his interest in the welfare of the employees of this great organization has made West Allis a unique place.

THE CEDAR-POLE INDUSTRY.

ADDRESS BEFORE THE CHICAGO ELECTRIC CLUB.

The evolution of the cedar pole from its primitive state in the forests to its installation as an important factor in the transmission systems of electric light, telegraph and telephone companies was interestingly recounted in an address by Ernest L. Clark, president of the Valentine-Clark Company, Chicago, before the Chicago Electric Club on Wednesday, September 14.

Cedar poles distributed from Chicago are grown in the states of Michigan, Wisconsin and Minnesota. The poles are cut and shipped, generally by water, where they are sorted, according to their size, into groups and thence distributed to the various consumers. The demand for Michigan cedar poles since 1880, according to Mr. Clark, has been so great that a scarcity of first quality poles is encountered by the producers and the time is not very far distant when the local supply will be exhausted. This condition is due not only to the demand for cedar poles, but to the exacting requirements regarding size and quality demanded by the consumers. Mr. Clark said that under present conditions an area of perhaps 100 square miles would have to be covered to fill an order of 4,000 or 5,000 poles.

This scarcity of cedar poles in the states mentioned has led to the development of the pole industry in Idaho and the Pacific Coast states and Mr. Clark asserted that the supply would eventually have to come from those states. Comparing the quality of the western poles with those produced in the east Mr. Clark said that while inferior in many respects the sizes are more in accordance with present requirements and notwithstanding the high rate of transportation western cedar poles could be shipped and treated at practically the same cost as the local product.

Regarding treating the speaker said that with a proper treatment the western pole could be made just as lasting as the Michigan pole and he looks forward to the time when the western states will supply practically the entire demand. Cedar poles are still very plentiful in the west, according to the speaker.

Replying to a question as to the nature of the treatment Mr. Clark strongly advocated the open-tank process in preference to the vacuum method.

Mr. Mott asked if there are any specific results obtained from the use of open-tank treated poles to point to. Mr. Clark referred to an installation in Denver where treated poles have been installed for seven years and are still in excellent condition.

After brief remarks by Messrs. Dulaney, Porter, Hickok and Lukes the meeting adjourned.

The regular weekly meetings of the club were resumed on Wednesday September 7, at the Kuntz-Remmler Restaurant, after a brief vacation period. A good-sized attendance was on hand and the remarks of S. Morgan Bushnell, manager Illinois Maintenance Company, on "Notes on a Vacation Trip in Europe," were very interesting.

Convention of Municipal Electricians.

The fifteenth annual convention of the International Association of Municipal Electricians was held at the Convention Hall, in Rochester, N. Y., September 6 to 9. The Power Hotel was the headquarters.

At the opening meeting the mayor's clerk, Charles Ogden, made an address of welcome, to which C. E. Diehl, of Harrisburg, Pa., responded on behalf of the association. At the afternoon session the president appointed a nominating committee, consisting of W. Y. Ellett, R. A. Smith, A. Bosch, A. L. Pierce and W. H. Thompson. A paper on "Underground Work" was then presented by J. B. Yeakle and C. R. George.

In the discussion W. H. Flandreau, of Mt. Vernon, N. Y. paid a tribute to the value of membership in the association in that it had enabled him to put in an underground system which was very complete at a lower figure than had ever been done before, the telephone engineers of the Bell Telephone Company being the authority for the assertion.

T. C. O'Hearn presented a paper giving tests that had been made in Altoona, Pa., and some under his own supervision at Cambridge, Mass., to determine the danger to firemen playing on live wires at fires. These tests seem to show that at a distance of ten feet or over the men would receive no appreciable shock.

At the Wednesday morning session a paper by Walter M. Petty, of Rutherford, N. J., was read, entitled "Lightning Protection." This will be published in full in our next issue. The discussion which followed finally drifted around to the advisability of grounding the shell of all fire-alarm boxes. The president appointed T. C. O'Hearn, W. H. Thompson, P. H. McManus, Jas. Grant and A. C. Toward a committee to secure any information possible on this subject and report at next meeting.

Mr. Kelley's paper on "Wireless Telegraph and Telephone" was read. The author gave a very interesting exhibition by means of a Victor talking machine, located about two hundred and fifty feet away in another room, giving selections of grand opera by wireless telephone, after which a general entertainment was given with the Dictograph transmitter and the Sonorophone, an invention of the author.

On Thursday, R. A. Smith presented a paper on "City and National Code Rules." He took copies of the Code and in detail called attention to the several sections and rules that had not been changed. In the afternoon the following officers were elected: President, H. C. Bundy, Watertown, N. Y.; first vice-president, J. S. Craig, Toronto, Canada; second vice-president, J. W. Kelley, Jr., Camden, N. J.; third vice-president, John G. Kreatz, Buffalo, N. Y.; fourth vice-president, John Berry, Indianapolis, Ind.; secretary, C. R. George, Houston, Tex.; treasurer, C. E. Diehl, Harrisburg, Pa

At Friday's session a paper by H. C. Bundy, entitled "The Telephone and Fire Department," was read by the secretary. General discussion ensued on this topic, the majority of the members being opposed to telephonic fire calls.

W. Y. Ellett eulogized the work of the retiring secretary, Frank P. Foster, and on behalf of the members presented him with a silver service. Mr. Foster responded feelingly and said that the work had always been a pleasure.

A paper by A. S. Hatch, on "Inductive Loads of Low Power-Factor" was then presented.

Exhibits were made by Crouse-Hinds, of Syracuse, N. Y.; Standard Underground Cable Company, Pittsburg, Pa.; W. N. Mathews & Brother, St. Louis, Mo.; Safety Insulated Wire and Cable Company, New York City.

The New United States Submarine Boat "Salmon."

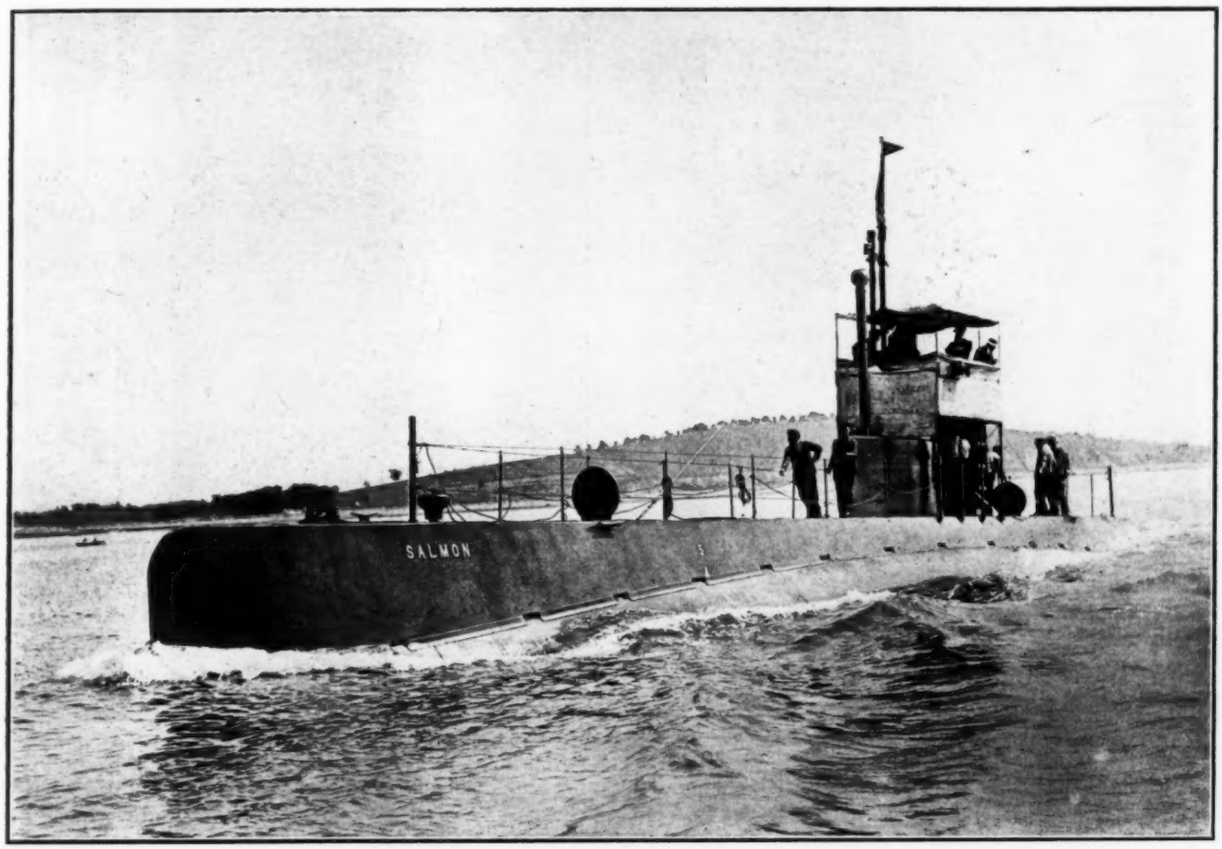
Improved Electrical Equipment Makes Possible Record-Breaking Trip.

BY WALDON FAWCETT.

Electrical power which has made possible the development of the modern submarine boat has been used more extensively and more effectively than ever in the case of the new submarine boat *Salmon* lately completed by the Electric Boat Company at the Fore River shipbuilding plant at Quincy Point, Mass. The *Salmon* is the vessel of this type most recently constructed for the United States Navy and consequently takes on a certain significance purely as the latest model in a field of invention where constant evolution and improvement is yet to be expected. From quite another standpoint, however, has the *Salmon* commended herself to the attention of the electrical and mechanical world. She has demonstrated an ability for long-distance cruising, the possession of which in this type of craft has heretofore been only theoretical, and in consequence she has been acclaimed, not only in this country but abroad, the most interesting submarine in the world.

In the earlier days of the electrically operated submarine boat the functions of the under-water torpedo craft were supposed to be virtually restricted to operations from a shore base—in other words to the sphere of harbor defense and kindred activities. Within the past few years, however, the United States Navy Department, coincident with similar ambition on the part of foreign naval officials, has undertaken to give the submarines a wider radius of action. In line with this policy American submarines have undertaken more or less extended cruises, the most notable of which have been the run of the United States ship *Viper* from Cape Lookout to Annapolis, Md., a distance of about 483 knots, and the cruise of a flotilla of submarines from New York to Annapolis, a distance of 385 knots. Now the *Salmon* has surpassed all these coastwise cruises and indeed opened an entirely new field of achievement by a cruise from the Atlantic seaboard to Bermuda and return.

In her recent cruise between Quincy, Mass., and Hamilton, Bermuda, and return occupying an interval of twelve days the *Salmon* covered a distance of approximately 1,600 miles. This deep-sea run is, in every sense, an innovation, being not only the first cruise by a submarine to a foreign port or out of sight of land, but the longest virtually continuous run ever attempted by such a vessel. Not only does the cruise establish a new record for the American navy, but it surpasses all foreign achievements. English submarines of



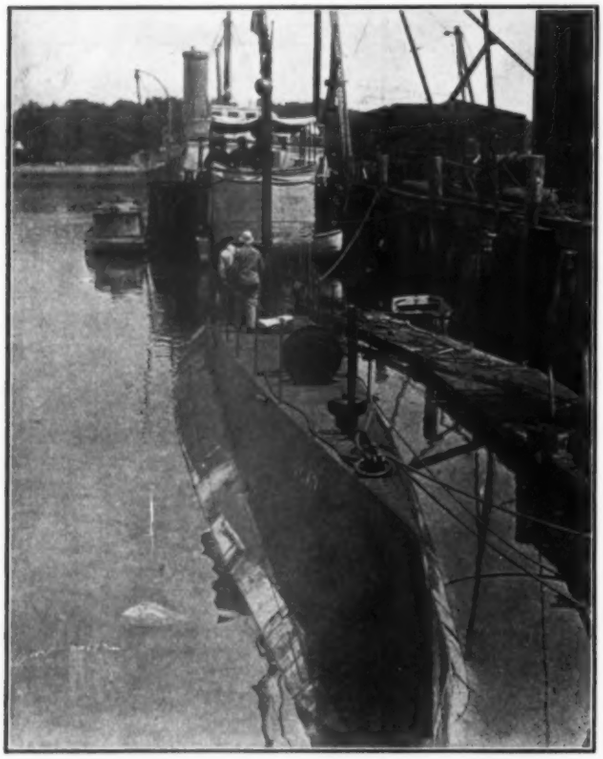
UNITED STATES SUBMARINE "SALMON" AT FULL SPEED EN ROUTE TO BERMUDA.

about the size of the *Salmon* have made the coastwise run from Dover to Dundee, a distance of 512 miles, and the French submarine *Papin* on one occasion made a coastwise cruise of 1,200 miles. However, the *Papin* is a much larger vessel, being of 550 tons displacement, whereas the *Salmon* is of but 320 tons displacement. Moreover, the cruise of the French vessel from Rochefort to Oran was a coastwise one and consequently in no sense comparable with the *Salmon's* achievement.

The *Salmon* is a development of the original Holland type of submarine and is 135 feet in length by fourteen feet beam. She is a sister ship of the *Norwhal* and *Grayling*, which were delivered to the Navy Department about a year ago, but in some respects seems to be the superior of either vessel. The *Salmon*, like others of her class, is a twin-screw boat, being driven on the surface by two 300-horsepower gasoline engines and propelled when submerged by electrical power supplied from storage batteries. Her armament consists of four torpedo tubes equipped to fire the latest type of torpedo—that is, a torpedo seventeen feet in length and eighteen inches in diameter, having a radius of 4,000 yards and carrying an explosive charge of 200 pounds of guncotton.

The most notable advance represented by the design of the *Salmon* is found in certain changes which have been made in the electrical equipment, which have enabled such an increase in the submerged speed of the vessel as to enable her to rank as the speediest submarine in the world. In the recent tests off Provincetown, Mass., she attained a submerged speed of more than twelve knots, the highest submerged speed ever attained by any submarine and fully fifty per cent faster than that of any European submarine. Another improvement brought about by the perfecting of the electrical equipment is a great increase in the radius of action under water, which is now placed at 115 knots at an economical speed. Finally, there has been a material reduction of the time necessary to change from surface running by means of gasoline engines to submerged operation by electrical power, and under the bettered conditions only three minutes is required to make the change.

In her speed tests the *Salmon* maintained a speed on the surface of nearly fourteen knots for upward of seventy hours of continuous operation, but ordinary cruising speed of from six to ten knots was the rule during the run to and from Bermuda, the slower speed obtaining during the very rough weather that was encountered during the outbound voyage. About 6,000 gallons of gasoline were consumed on the voyage. Four officers and a crew of twenty-one men were carried on the voyage to Bermuda and there was no discomfort. At the same time it was demonstrated on this cruise that a submarine under actual service conditions can be operated, in so far as navigation is concerned, by five men, two on the bridge and three in the engine room. On the voyage there was a change of watches as on any other naval vessel, but only five men, as stated, were required to operate and navigate the vessel. On two days during the voyage the *Salmon* was kept closed, as the captain expressed it, "tight as a drum," but there was no indication of bad air, nor was it necessary to draw upon the reserve supply of 4,800 cubic feet of air contained in twenty-eight tanks. It may be added that electrical apparatus is available for forcing foul atmosphere from the hold of the submarine and drawing a sup-



THE "SALMON" AT DOCK BEFORE RUN TO BERMUDA.

CRUISING BRIDGE, INSTALLED FOR BERMUDA RUN.

ply of fresh air from the air tanks.

What might be termed the supplementary equipment of the *Salmon*—and it is largely electrical in character—is likely to represent approved practice for some time to come. Electrical ranges are provided for the cooking operations and there is a double periscope system and a complete submarine signaling system for both sending and receiving. A diver's helmet with life preserver attached is provided for every person on board for use in the event of a disastrous collision under water, which is almost the only form of accident to be feared. In tests for submerged stability the electrical equipment of the *Salmon* has been employed for diving to a depth of 200 feet. At that depth the vessel gave no indication of strain or leakage and the builders claim that she is capable of being submerged to a depth of 250 feet (nearly twice the depth attained by any European submarine) without danger.

On her recent cruise to Bermuda the *Salmon* carried Lieut. D. A. Weaver of the United States Navy, who is to be the first commander of the vessel after she is turned over to the Government; Captain D. R. Battle, constructor, United States Navy; Gregory C. Davidson, forerly an officer of the United States Navy and now vice-president of the Electric Boat Company; and Captain Arturo Cuevas of the Chilean Navy. Unusual significance attaches to the presence of the Chilean officer, inasmuch as it is an open secret that this novel cruise was undertaken largely to demonstrate to the various South American republics the sea-going capabilities of a modern submarine and the ability of such craft to be entirely self-supporting. As is well known, several of the leading South American nations have lately shown great activity in the upbuilding of their navies and it is stated that the defensive problems of those countries with extensive coast lines strongly impel them to have recourse to American-built submarines, if they can be convinced that such vessels are in every way qualified for service under all sorts of conditions.

Electric Haulage in Indiana Mines.

Two of the principal mines of the Indiana Coal Company are being equipped with electric haulage systems.

Reunion of Old Time Telegraphers.

The twenty-ninth annual reunion of the Old Time Telegraphers' and Historical Association and of the Society of the United States Military Telegraph Corps was held in Chicago on September 8, 9 and 10. Headquarters were established at the Auditorium Hotel, where a joint meeting of the two organizations was held on Thursday morning.

At this meeting W. J. Lloyd, of Chicago, was installed as the new president of the Old Time Telegraphers. After receiving the annual reports of the secretary and treasurer, a resolution was adopted indorsing the movement to erect a monument at the site of the Erie Railroad station at Turners, N. Y., where occurred the birth of telegraph train dispatching. The committee on the next reunion and nominations reported in favor of Atlantic City, N. J., as the place, the time to be determined by the executive committee. This recommendation was concurred in. Nominations for officers for the coming year were also submitted and by unanimous vote these were declared elected as follows:

President, Wm. Bender Wilson.

Vice-presidents, W. A. Sawyer, F. E. Maize and C. E. Bagley.

Secretary and treasurer, F. J. Scherrer.

The rest of the time of the three-days reunion was given over to an extended programme of entertainments. On Thursday afternoon the members and visitors attended a National League baseball game. That evening a number of amusement parks were visited. On Friday a special train on the Chicago & Northwestern Railway was provided for a trip to Highland Park, where luncheon was served at the Hotel Moraine to the entire party as guests of Vice-president Fred W. Cushing. On Friday evening a theater party was given. Saturday was devoted to sightseeing, many points of interest about Chicago being visited.

During the lull between these events the ladies did considerable shopping, while the verterans of the key swapped stories and reminiscences of former days. Although the ranks of the United States Military Telegraph Corps are rapidly being thinned and consequently there were but few of its members present, their anecdotes of stirring events during the Civil War were listened to with renewed interest.

On Saturday evening a banquet was held in the Gold Room of the Auditorium Hotel, the introductory address being made by W. J. Lloyd, president of the Association. B. E. Sunny, president of the Chicago Telephone Company, acted as toastmaster. Addresses were made by B. G. Mullaney, representing the City of Chicago, and by Col. William Bender Wilson, president of the Society of the Military Telegraph Corps, and W. R. Plumb, Charles S. Holt, A. H. Bliss, Frank Loesch, M. J. O'Leary and John B. Taltaval.

Ohio Telephone Assessments Raised.

The Ohio Tax Commission has announced that its valuations of the property of most of the telephone companies in the state will be practically double those of last year.

The Columbus Citizens' Telephone Company valuation will be raised from $424,927 to $1,000,000; the Toledo Home Telephone Company from $420,435 to $1,000,000; the Dayton Home Telephone Company from $199,355 to $500,000; Central District Telephone Company from $368,668 to $700,000; Cuyahoga Telephone Company from $972,121 to $2,000,000; Cincinnati and Suburban Bell Telephone Company nearly $2,000,000 above the 1909 valuation; Central Union Telephone Company increased to $5,000,000; Cleveland Telephone Company increased to $3,000,00; United States Long Distance Telephone Company increased to $1,300,000.

The Commission obtained a line on the actual value of many of these properties through the sales that were made of them to the J. P. Morgan syndicate during the past year.

New Wireless Stations.

The Marconi Wireless Telegraph Company of America recently announced the opening of the wireless station at Glace Bay, N. S., and Clifden, Ireland.

Messages for the United Kingdom only will be accepted at the rate of seventeen cents per word and will be forwarded over the land lines to Glace Bay for transmission to any point in the United Kingdom. The service has not yet been extended to the Continent.

Power Station for Faröe Islands.

From an English source it is learned that a power station will be built to utilize the Fosaven Falls, Faröe Islands, to furnish cheap power and light.

The Allis-Chalmers Company.

An Industrial Organization Typical of Electrical Progress.

In the growth of all large business enterprises in this country there can usually be found one fundamental guiding principle. Throughout its entire growth and extension this principle finds marked expression and the success of the concern and the character of its product are usually accurate indexes of it.

While the products of the Allis-Chalmers Company are many and varied, the readers of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN will be particularly interested in its power and electrical apparatus. From the origin of this company its aim has been to be in advance of usual methods of manufacture and construction. Its executive officers and engineers have worked harmoniously to improve the construction of existing plant, and add new apparatus to meet growing needs. In everything which has left the works of this company the aim has been to have it a perfect machine and one which would give satisfaction; not an article to be sold at a cheap price, but one which would give faithful and lasting service and which would maintain the assertion of the company that its apparatus was "built on merit."

The reputation which this company has deservedly won for its reciprocating steam engines started in a very small way when, in 1868, the first engine was constructed in its shops. This was a 180-horsepower machine built to drive a flour mill. Some few engines were built in the succeeding years, but the real progress of the company in this line did not begin until 1877, when Edwin Reynolds became general superintendent of the Edward P. Allis Company and brought out the much improved Corliss engine.

In 1880 the company built the first high-duty pumping engine for the city of Milwaukee with which a duty was secured superior to that of any engine previously built. Since that time the company has developed the pumping engine to a position where it is the most efficient steam machine that can be produced, and its pumping engines hold the world's records for economy. There is hardly a large pumping station in the United States in which Allis-Chalmers pumping engines cannot be found.

Not only with pumping engines has this company established an enviable reputation, but also with centrifugal pumping machinery. Its apparatus of this type has been used in the greater part of the low-head, large-volume, water-moving projects of the country. Many of the reclamation-service installations and the sewage pumps of Chicago are examples of its achievement in this line.

As an indication of the advanced position which the company took and as evidence of the character of the work which it turned out, it is only necessary to call attention to the so-called "Manhattan" engines which it built and installed in the power house of the Interborough Rapid Transit Company in 1902 and 1903. These engines were the largest that had ever been built and showed an economy unsurpassed in that class of service. Each engine develops 12,000 horsepower, and this installation stands as a monument to the steam-engine builder.

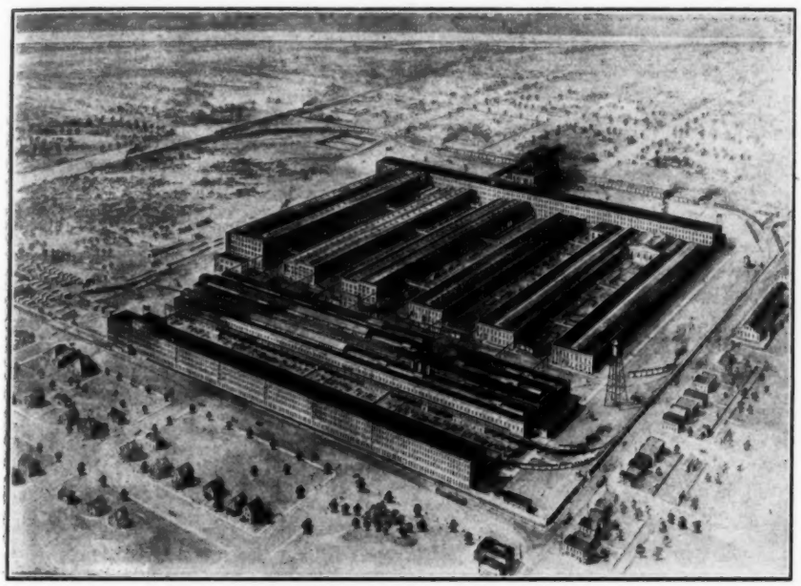
Up to this time the company had done practically nothing in the field of electrical engineering. Its engines had been used to drive electrical machinery and its engineers were somewhat familiar with the field, but the company had not actively entered into this line. Realizing that much of the future work of the country would be done with electricity, it began the manufacture of electrical apparatus in a small way. This was followed in 1903 by the purchase of the Bullock Electric Manufacturing Company, a company with a long record of successful installations and a staff of wide-awake engineers. Thus began the electrical business of the company, which has brought it to the forefront as one of the largest builders of this class of apparatus. For a comparatively short time all the electrical machinery was built at the Bullock works, but, with the completion of the new buildings at West Allis in 1905, electrical apparatus was built there also. At present all of the larger units are built at West Allis, while the smaller and standard machinery is built at the Bullock works. Users of electrical machinery are familiar with the product of this company, which includes generators of all types and sizes, motors for every class of service, motor-generators, rotary converters, switchboards, controllers, etc., in fact everything in the way of electrical apparatus.

Among the other work which the company does, sight should not be lost of its hydraulic power apparatus. Three installations are sufficient to show the variety of conditions under which this machinery has been used. The largest hydraulic turbine using a single Francis wheel and developing 13,500 horsepower was built by this company. It also built a hydraulic turbine to operate under a head of 1,800 feet, which is probably the highest head ever employed. It likewise has turbines operating under as low a head as seven feet.

Holding a leading position as a manufacturer of prime movers, it was only natural that the Allis-Chalmers Company should become greatly interested in the introduction of the steam turbine and the gas engine, and its connection with these two types has been one of the greatest factors in the development of these machines.

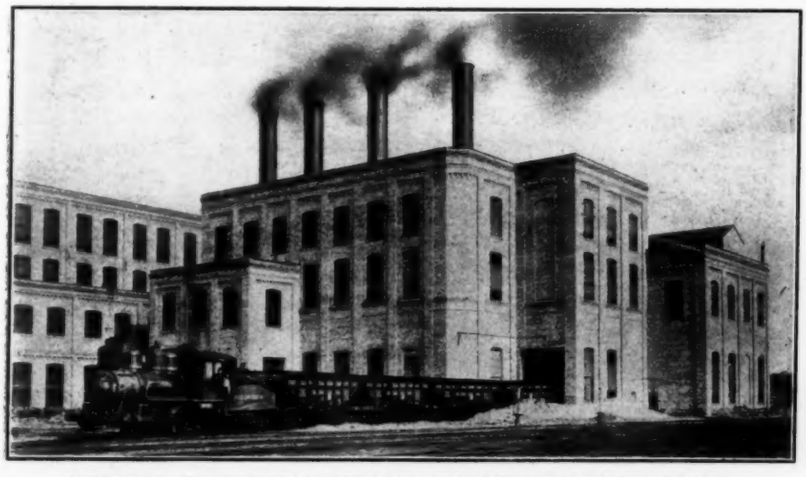
Realizing the advantage which a continuously rotating machine has, under certain conditions, the company early made arrangements with the Honorable Charles A. Parsons for the manufacture of the Parsons turbine in this country. This is of the now familiar horizontal, multiple-expansion, parallel, full-annular-flow, reaction type. While Mr. Parsons produced the first practical machine of this type and had built these for several years, during which time he experienced the difficulties usual with a new machine, the Allis-Chalmers Company still found opportunity to improve greatly the design and method of construction. Its engineers carefully studied the machine which Mr. Parsons had built and the information which he supplied, and developed a turbine of extremely high efficiency and of such a character that it does not deteriorate in the least in operation. The most important improvements made were probably the

shroud ring, which holds the blades firmly in place and prevents any chance contact and disarrangement from their fixed position, and the low-pressure balance piston. The latter has done much to reduce the trouble experienced with end thrust in the early machines. These insure a maintenance of high efficiency. Its systems of governing and lubricating the bearings have done much to make this piece of apparatus absolutely reliable. The company builds standard machines from 300 to 10,000 kilowatts both in high-pressure and low-pressure types. These are being used in railway, lighting, and in all sorts of manufacturing enterprises. To date the company has installed turbines aggregating 250,000 kilowatts, and it has the proud record of having all these machines now in operation.



WEST ALLIS WORKS OF ALLIS-CHALMERS COMPANY.

In the latter part of the nineteenth century and the beginning of the twentieth, engineers began the consideration of the use of large gas engines. It is quite probable that credit for early work in this line is due the engineering profession of Germany, but the greatest development has been in this country and the Allis-Chalmers Company has taken a leading part in bringing about the successful use of this type of prime mover. Starting in 1903 with experience gained by the Nuermberg Company, the first engine was designed and built and put in experimental operation in the plant of the company during the latter part of 1904. Over a year was spent in careful experiments with this engine and the studies made then and since have been extremely useful in the development of the gas engine to its present highly efficient and reliable condition. This engine is built on the four-cycle principle and it is made either in the single, tandem or twin-tandem form. It is built in sizes from 300 to 5,000 horsepower and designs have been prepared for even much larger units. These engines have been designed to operate either on natural, producer, or blast-furnace gas, and their adaptation to the last named fuel has done much toward the development of the steel industry and the utilization of what were formerly waste gases.



COMPANY'S TRAIN UNLOADING COAL AT WEST ALLIS POWER PLANT.

These engines have been used to drive machinery directly or through belting, but probably the larger number of them have been direct-connected to electric generators. They furnish power for varied sorts of manufacturing industries, for central stations, for trolley lines, for blast furnaces, etc. Most engineers are already familiar with the use of these gas engines at the Gary plant of the Indiana Steel Company, where seventeen of them are used in one power house to drive generators which furnish power for this immense plant. Eight others are direct-connected to blowing tubes for supplying the blast to the furnaces. These engines were rated at 2,000 kilowatts, but have been continuously developing 2,600 kilowatts. One of the recent orders from the Indiana Steel Company was for six additional units for this plant. These will be the largest gas engines ever built, developing 5,000 horsepower and having cylinders forty-four by sixty inches. When these are installed the gas-engine power-plant will have a capacity of over 150,000 horsepower, and will be the largest plant of its kind in the world. With these and the engines in the other plants of the United States Steel Corporation, the Allis-Chalmers Company has supplied this biggest business enterprise sixty-two gas-engine units and its total output of gas engines now measures over 300,000 brake-horsepower.

For the carrying on of its manufacturing, the Allis-Chalmers Company has six large plants, the biggest and most modern of which is located at

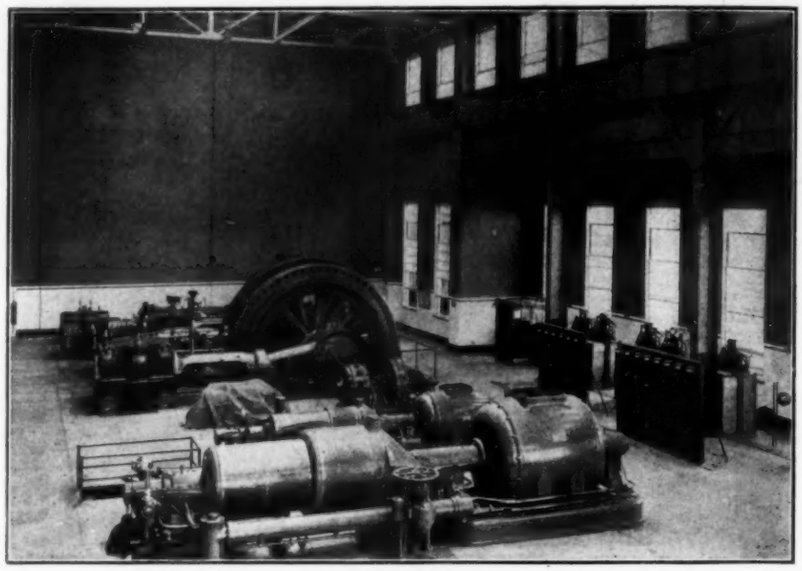
West Allis, Wis., near Milwaukee. This is the largest machinery-manufacturing plant in the West and in point of equipment and methods employed is second to none in the world. System is the keynote, and the plant and movement of material are both arranged for large production on an economical scale.

The accompanying illustrations will serve to give only an inadequate conception of the magnitude of these works. The site occupied by the plant covers 110 acres and the buildings have a floor area of over one and one-half million square feet.

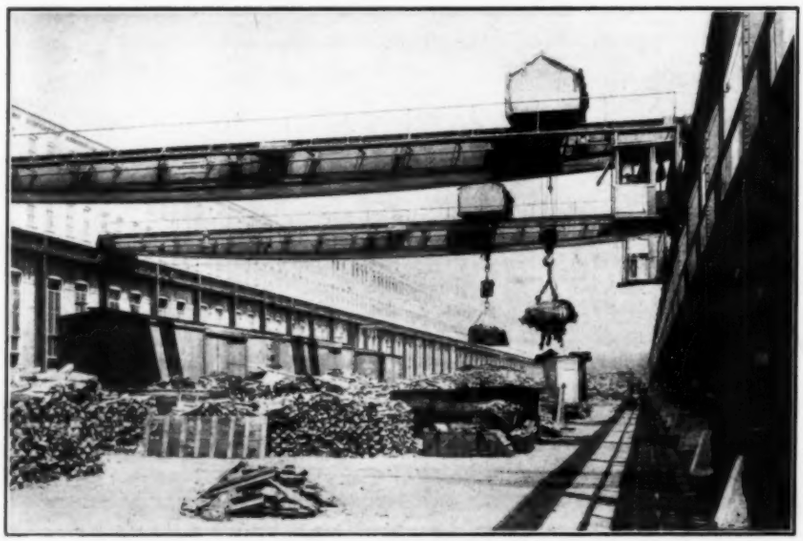
A power house developing over 12,000 horsepower, and high-tension distribution to substations in each shop, supply the power for driving the machines. For the most part direct current from a multivoltage system with individual drive is used. A large amount of special machinery, developed for accurate and rapid work, together with the employment of only the most highly skilled workmen, produces a product of which the company is proud.

With the growth in its own business until it became one of the foremost manufacturing concerns in the country, and in keeping with the spirit of the time, the Edward P. Allis Company in 1900 was consolidated with several other concerns and the Allis-Chalmers Company was formed. The companies in the merger were the Edward P. Allis Company, which was the leading spirit; the Gates Iron Works, of Chicago, manufacturers of rock-crushing, cement and mining machinery; Fraser & Chalmers Company, of Chicago, which was a manufacturer of mining machinery, pumps and air compressors; and the Dickson Manufacturing Company, of Scranton, which did a large business in Corliss engines and special machinery. As already mentioned, this was followed in 1903 by the absorption of the Bullock Company. The result of this combination made the Allis-Chalmers Company not only pre-eminent in the enterprises with which the E. P. Allis Company was originally identified, but it became a leader in all the lines mentioned, which position it has maintained to the present day.

This, in brief, is an outline of the growth of one of the leaders of America's manufacturing companies. Beginning with a handful of men it has grown until at the present day, under the direction of Walter H. Whiteside, president, there are employed about 14,000 men in its six different manufacturing establishments and in the sales offices all over the world. The desire of the founder of the original E. P. Allis Company to have his company a leader in manufacturing enterprises and to have the product of such a character that it would always give satisfaction, was faithfully carried out during his lifetime and this is also the chief aim of the man who is now the leading spirit of the company. Here, in this company, is exemplified the statement that there always exists some firm guiding principle which is lasting in a successful business and which must be present if that success is to be attained. The success of this policy has been amply demonstrated.



POWER HOUSE, WEST ALLIS WORKS, ALLIS-CHALMERS COMPANY.



MAGNET HANDLING IRON KNUCKLES IN WEST ALLIS FOUNDRY YARD.

Guayule Exports from Mexico.

Statistics recently compiled by the government of Mexico show that during the past year the exportation of crude rubber manufactured from the guayule shrub amounted to $16,760,068, and the value of the shrub exported was $9,468,121. This is more than double the value of the shrub and crude rubber exported during the twelve months previous. D.

SECTION OF FOUNDRY, MILWAUKEE.

MAIN AISLE OF SHOP NO. 5, MILWAUKEE.

STEAM-TURBINE ERECTING SHOP, MILWAUKEE.

CENTER AISLE, SHOP NO. 3, CINCINNATI.

GAS-ENGINE ERECTING SHOP, MILWAUKEE.

NORTH END OF PATTERN SHOP, MILWAUKEE.

Association of Edison Illuminating Companies.

The twenty-sixth annual meeting, constituting the thirty-first convention, of the Association of Edison Illuminating Companies was held at the Hotel Frontenac, Frontenac, N. Y., on September 6, 7 and 8. The meeting was the largest and one of the best gatherings of Edison central-station men ever assembled. The beautiful scenery of the Thousand Islands helped swell the attendance to 175 delegates.

As usual at these gatherings a fine programme of entertainments was provided. The crowning feature in this line was the annual dinner held on Wednesday night, which was attended by all the delegates and visitors present. Thomas A. Edison was the guest of honor. No speeches were made after the dinner, but a delightful musical programme was rendered and greatly appreciated.

The five technical sessions were carried out strictly according to schedule and the following reports and papers were presented:

Tuesday morning.—Annual address by President Thomas E. Murray, New York. Report of the Executive Committee, presented by Secretary N. T. Wilcox, Lowell, Mass. Report of Treasurer Louis A. Ferguson, Chicago. Report of the Committee on Meters, Joseph W. Cowles, Boston, chairman. Report of Committee on Storage Batteries, S. C. Harris, New York City, chairman. Paper on "The 1910 Edison Storage Battery," W. E. Holland, Orange, N. J. Special report of tests by the Electrical Testing Laboratories on the Edison storage battery made under the direction of the Lamp Committee. Paper on "Purchase Inspection of Central-station Apparatus," F. M. Farmer, New York City.

Tuesday evening.—Three papers as follows: "Recent Employers' Liability Legislation as Affecting Central Stations," E. M. Atkin and H. M. Edwards, New York City. "Reasonable Profit—Its Definition, Collection and Distribution," James V. Oxtoby, Detroit, Mich. "The Welfare of Workers—Some Notes on European Conditions," Arthur Williams, New York City.

Wednesday morning.—Report of Committee on National Code, W. C. L. Eglin, Philadelphia, chairman. Report of Committee on High-potential Disturbances, Philip Torchio, New York City, chairman. Report of Committee on Steam Turbines, Alex Dow, Detroit, Mich., chairman. Four papers as follows: "Canvassing by Telephone," T. I. Jones, Brooklyn, N. Y. "Ideas, Suggestions and Methods of the Commercial Department," J. D. Israel, Philadelphia, Pa. "Breakdown Connections to Isolated Plants," M. F. McAlpin, New York City. "The Heating Problem in Its Relation to Central-station Service," R. P. Bolton, New York City.

Wednesday afternoon.—Five papers as follows: "The Promise of Electrified Agriculture," E. D. Edwards, Schenectady, N. Y. "Characteristics and Operation of Relays for Tripping Oil Circuit-breakers," A. S. Loizeaux, Baltimore, Md. "Display Street Lighting in Toledo, Ohio," W. E. Richards, Toledo. "Measuring Demand—Power Factor as Affecting Rates and Demand," R. S. Hale, Boston, Mass. "An Analysis of Diversity Factors," H. B. Gear, Chicago, Ill. Report of Committee on Electric Heating and Kindred Uses, John F. Gilchrist, Chicago, chairman.

Thursday morning.—Report of Committee on Incandescent Lamps, J. W. Lieb, Jr., New York City, chairman. Paper on "Experience with Lamp Renewals," Louis A. Ferguson, Chicago. Report of Committee on Electric Vehicles, James T. Hutchings, Rochester, N. Y., chairman. Supplementary report on electric vehicle batteries, by the Committee on Storage Batteries. Paper on "The Electric Vehicle as a Promoter of Central-station Business," P. D. Wagoner, Long Island City, N. Y. Paper on "The Illumination of Streets," Preston S. Millar, New York City.

The election of officers resulted in the unanimous re-election of all the retiring officers, as follows: President, Thomas E. Murray, New York, N. Y. Vice-president, Charles R. Huntley, Buffalo, N. Y. Treasurer, Louis A. Ferguson, Chicago, Ill. Secretary, N. T. Wilcox, Lowell, Mass. Assistant Secretary, Walter Neumuller, New York, N. Y. Members of the Executive Committee: Thos. E. Murray, New York; Samuel Insull, Chicago; Charles L. Edgar, Boston; John W. Lieb, Jr., New York; Joseph B. McCall, Philadelphia; W. W. Freeman, Brooklyn; Charles R. Huntley, Buffalo; Louis A. Ferguson, Chicago; N. T. Wilcox, Lowell.

Chicago Traction Tunnel Near Completion.

The $590,000 Washington Street tunnel in Chicago is expected to be completed by October 1 and John M. Roach, president of the Chicago Railways Company, has gone on record to the effect that by November 5 he hopes to have cars operating in it to relieve traffic congestion.

Under the river the tunnel is practically completed and the section from Clinton Street to Market Street is built. Record time was made by the contractors, George W. Jackson, Inc., in the construction, which will be finished three months ahead of the contract time.

Unique methods were adopted by the engineers in charge. In order not to disturb the foundations of abutting buildings the greatest opening made under ground never exceeded a space 9 by 7 feet until the retaining walls and roof were in. The result has been that not a single building has sunk. This method was employed on account of the fact that owing to the roof of the old tunnel being still in place, a shield could not be used in driving the tunnel. The plan adopted forms the subject of a patent by Mr. Jackson.

Underneath the river the roof of the tunnel is flat and under the streets it is arched. The height runs from fourteen feet under the river bed, to twenty feet under the streets. The bore is 1,606 feet long and forty-two feet wide. A wall divides the tunnel into two parts. This makes the tunnel self-ventilating, as the cars going through would force the bad air out.

Officials of the public utility service corporations are praising the Jackson company for not interfering with their operations. The big conduit filled with wires and pipes that ran along the north side of the tunnel was not put out of commission for an instant. It was moved on jacks and the telephone and other service maintained without a break.

New Electric Smelting Plant.

The Electric Smelting and Aluminum Company has purchased thirty acres of ground at Woodbridge, N. J., on which it will build a large factory at once. Arrangements for building a dock and securing railroad connections are also being made. The concern intends to erect workmen's houses also.

HOW TO DESIGN A CONSTANT-POTENTIAL DIRECT-CURRENT DYNAMO.

BY W. T. RYAN.

A good dynamo cannot be designed by mere rules. There are, however, certain fundamental scientific principles which must be taken into consideration and which can be laid down definitely and taught with precision. Dynamos are usually made to be sold. The successful designer must produce a machine which, as well as being efficient, can be manufactured and sold at a profit. It is the purpose of this article to present as briefly and clearly as possible the fundamental principles upon which the design necessarily rests. A knowledge of machinery and its construction, an acquaintance with the successful forms that exist and the perception of why they are successful, etc., must and can be acquired only by experience.

GIVEN.

Kilowatt capacity.

Voltage (no load and full load).

Allowable temperature rise.

Speed (see Tables I, II and III).

TABLE I.
HIGH-SPEED BELTED DYNAMOS.

Kilowatt Capacity.	Revolutions per minute.
1	1200 to 3000
3	1000 to 2000
10	950 to 1900
20	900 to 1600
40	750 to 1300
60	650 to 1100
100	550 to 800
300	400 to 500
500	350 to 400

TABLE II.
LOW-SPEED BELTED DYNAMOS.

Kilowatt Capacity.	Revolutions per minute.
1	700 to 1300
3	650 to 1200
10	600 to 1000
20	500 to 900
40	475 to 700
60	450 to 650
100	400 to 600
300	350 to 450
500	300 to 350

TABLE III.
DIRECT-CONNECTED DYNAMOS.

Kilowatt Capacity.	Revolutions per minute.
10	325 to 500
20	275 to 400
40	200 to 350
60	150 to 300
100	120 to 275
500	75 to 125
1000	70 to 125

CALCULATIONS.

(*A*) *Number of Poles.* The number of poles may be determined from the following formulas due to Press:

$$D^2L = \frac{2.2 \times 10^4 \,(1.5+\sqrt{k})^2}{r} \qquad (1)$$

$$2^{\frac{p+4}{3}} = \frac{D^2L}{9156} \qquad (2)$$

where D = diameter of armature in inches.

L = length of core in inches.

p = number of poles.

k = kilowatts.

r = revolutions per minute.

Solving equations (1) and (2) the following equation is obtained for the number of poles.

$$p = \frac{2\log\left[\frac{2.4\,(1.5+\sqrt{k})^2}{r}\right]+4\log 2}{\log 2} \qquad (3)$$

The relation of the number of poles to capacity, which conforms with modern practice, is indicated by Table IV.

TABLE IV.
CAPACITY AND NUMBER OF POLES.

Type.	Kilowatt Output.	Number of Poles.
High-Speed Belted	0 to 10	2
" "	0 to 100	4
" "	50 to 500	6
Low-Speed Belted	0 to 300	4
" "	10 to 300	6
" "	100 to 500	8
Direct-Connected	0 to 50	4
"	10 to 300	6
"	100 to 400	8
"	200 to 800	10
"	300 to 1500	12
"	800 to 3000	16

(*B*) *Diameter and Length of Armature.* According to Press.

$$\frac{D}{L} = 0.55\,p \qquad (4)$$

Knowing the ratio of D to L, and having found D^2L from equation (1) we at once obtain values for D and L.

According to Thompson:

$$D^2L = \frac{k}{0.064\,r} \qquad (5)$$

where D = diameter of armature in feet.

L = length in feet.

$$D = \frac{12\,S}{\pi\,r} \qquad (6)$$

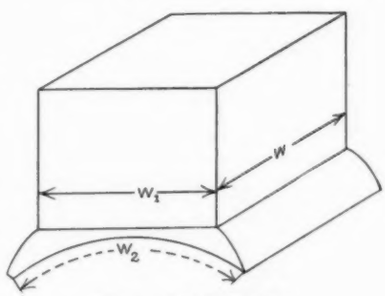


FIG. 1.—POLE PIECE.

where S = peripheral speed of armature in feet per minute.

L would then be equal to D divided by the ratio obtained above.

Tables V and VI should be used as a check both on L and the ratio of D to L.

TABLE V. (Esterline.)
DIAMETERS OF BELTED ARMATURES.

Kilowatt Capacity.	Diameter in inches (mean).	Ratio of length to diameter (mean).
1	7	0.65
1	9	0.63
10	11	0.62
20	14	0.59
50	21	0.52
100	29	0.44
150	34	0.40
300	44	0.38
500	54	0.32

An average of the above values as obtained for D and L will usually give a well-proportioned machine.

(*C*) *Breadth and circumferential width of pole.* A very good proportion is to make the breadth of the pole core, W, equal to the length of the armature core, L.

TABLE VI. (Esterline.)
DIAMETERS OF DIRECT-CONNECTED ARMATURES.

Kilowatt Capacity.	Diameter in inches (mean).	Ratio of length to diameter (mean).
15	22	0.25
50	27	0.25
100	34	0.22
200	47	0.22
500	80	0.20
1000	112	0.16
1400	130	0.15

Assuming a certain percentage of the armature surface, (usually about seventy per cent in new designs), to be covered by the pole shoes we can at once get W_2, the circumferential width of the pole. Another excellent proportion is to make $W_1 = W$. If a round pole core is used the diameter should be very nearly equal to L.

Another excellent form for the pole core is one whose section is a circle with a rectangle in the center. The length of the rectangle is equal to the diameter of the circle and should also be equal to the length of the armature core, L.

Adjustments of the ratio of D to L as well as many other points in the design, will have to be made in order to get these proportions.

(*D*) *Flux.* Assume an air-gap density in accordance with Table VII.

TABLE VII.
AIR GAP DENSITIES IN MAXWELLS PER SQUARE INCH.

Kilowatt Capacity.	Cast-iron poles.	Steel or wrought-iron poles.
1	23000	32000
5	26000	35000
10	28000	41000
50	32000	50000
100	35000	52000
300	37000	55000
500	44000	61000

Where the machine is to be used for electrolytic work values somewhat less than the above should be used.

$$\phi = W_2 W B \qquad (7)$$

Where ϕ = flux per pole.

W = breadth of pole core.

W_2 = circumferential width of pole shoe.

B = air-gap density.

(*E*) *Number of Inductors.*

$$Z = \frac{10^8\,E\,p_1}{n\,p\,\phi} \qquad (8)$$

Where Z = number of inductors on the armature.

p = number of poles.

p_1 = paths in parallel in the armature.

ϕ = flux per pole.

E = no-load electromotive force of the machine.

n = revolutions per second.

Choose a value of Z as near the calculated value as possible, which will be

divisible by numbers which in your judgment would be likely to be the number of inductors per slot and which will also permit you to use a reasonable number of slots. This number should be one more or less than a multiple of the number of poles. ϕ may then be adjusted accordingly.

The number of paths, p_1, in parallel in the armature depends on the type of winding used. If a wave winding is used there are almost always, though not necessarily, two paths in parallel through the armature regardless of the number of poles. The general form of the winding may be found in any one of several textbooks or handbooks.

The number of slots, coils per slot, and poles will quickly determine the geometrical construction. Certain combinations require the omission of one commutator bar. Others require the omission of a coil. Still others cannot be wound at all. It is entirely a question of geometrical construction which will work out. As a rule this can best be worked out by arranging a table of slot numbers. Only two brushes are required with a wave winding, although there may be as many as there are poles. The wave winding is quite generally used on railway motors on account of the inaccessibility of the lower brushes. It is often used on small motors, especially the 220-volt and 500-volt machines. It is seldom used on generators of any size. Sometimes the same set of coils are wave-wound on a four-pole machine for 220 volts and lap-wound for 110 volts.

With a lap winding there are usually as many paths in parallel as there are poles, though there may be two or more times this number. There must be as many brushes as there are poles. The general form of winding may be obtained from any one of several textbooks or from handbooks. The single lap winding in which there are as many paths as there are poles is the most generally used type of winding.

(F) Number of Slots and Commutator Bars. The number of slots should divide into the inductors an integral and preferably an even number of times. The slots should also be one more or less than a multiple of the number of poles.

TABLE VIII. (Esterline.)
NUMBER OF ARMATURE SLOTS.

Diameter of Armature in Inches.	Number of Slots. Minimum.	Mean.	Maximum.
10	25	45	75
20	50	90	135
30	75	125	196
40	95	160	240
60	125	220	325
100	175	300	450

The number of commutator bars will be either equal to or a multiple of the number of slots unless there are one or more dead coils, which is very unusual. Use 30 to 60 commutator bars per pair of poles for machines up to 250 volts. Use 60 to 90 commutator bars for machines from 250 volts to 600 volts. Wiener gives the following formulas for the minimum number of commutator bars.

For over 100 amperes per path,

$$N_c = \frac{E\,p_1}{20} \qquad (9)$$

For 50 to 100 amperes per path,

$$N_c = \frac{E\,p_1}{21} \qquad (10)$$

For 20 to 50 amperes per path,

$$N_c = \frac{E\,p_1}{23} \qquad (11)$$

For 2 to 5 amperes per path,

$$N_c = \frac{E\,p_1}{40} \qquad (12)$$

where N_c = number of commutator bars.

p_1 = number of paths in the armature.

The above determinations fix the number of armature coils, number of slots, number of turns per coil and number of commutator bars.

(G) Dimensions of Armature Inductors. Find the required dimensions of the armature inductors and see if they can be placed in the space available. Assume a certain percentage shunt-field current in accordance with Table IX, and add to this the total full-load current in order to get the total armature current. The current in one path will be the total armature current I_a divided by the number of paths in the armature.

TABLE IX. (Esterline.)
SHUNT-FIELD CURRENT.

Kilowatt Capacity.	Per cent Shunt-field Current.
0.25	9
1.0	6.4
5.0	4.5
10.0	3.75
20.0	3.
40.	2.4
100.	2.05
200.	2.0
600.	1.48
1000.	1.3
2000.	1.15

$$D_c^2 = K I_a' \qquad (13)$$

where D_c = diameter of armature inductor in mils.

D_c^2 = area in circular mils.

K = number of circular mils per ampere assumed.

For high-speed well-ventilated armatures, K=450 to 550. For low-speed well-ventilated armatures, K=550 to 650.. For poorly ventilated armatures, K=750 to 850.

If the inductors are round, the insulation should consist of at least a double cotton covering. The dimensions of the insulated wire may be obtained from a wire table. If rectangular conductors are used allow at least 14 mils for insulation between the individual inductors. About 0.031 inch should be allowed on either side and the bottom of the slot for insulation. There should be placed around each assembled coil at least one layer one-half overlapped of seven-mil tape. In addition to this there is often placed on that portion of the coil which is in the slot a wrapping consisting of one and one-half turns of about six-mil empire cloth or its equivalent. This wrapping should extend about one-half inch beyond either end of the armature core. This wrapping, is, of course, put under the cotton or linen tape referred to above. The assembled coil is then dipped in armalac or some other good insulating varnish.

The inductors must be so arranged in the slot as to give a well proportioned slot and tooth.

In order to get the average length of one turn of a coil lay the coil off to scale, as indicated by Fig. 2. Making a suitable allowance for the length of the commutator, calculate the length of conductor in each coil. The total length of conductor on the armature will then be the number of coils times the length of wire in each coil. The resistance of the armature, R_a, will then be

$$R_a = \frac{\text{resistance of all the wires in series}}{p_1^2} \qquad (14)$$

The heat loss in the armature will be $I_a^2 R_a$ and the voltage drop at full load will be

$$V_a = I_a R_a \qquad (15)$$

(H) Iron Losses in the Armature.

$$A_c = \frac{\phi}{2\,B_c} \qquad (16)$$

where A_c=cross-section of the armature core below the teeth.

B_c= magnetic density in the armature core.

The magnetic density in the core below the teeth should not exceed 70,000 maxwells per square inch. 60,000 to 65,000 are very good values.

Depth of core below teeth=A_c/L. . (17)

The length and width of the teeth, the area of the core below the teeth and the length of the armature being known, the volume of the core in cubic inches may be calculated.

$$W_c = .0277 V_c \qquad (18)$$

where W_c = weight of core in pounds.

V_c = volume of core in cubic inches.

There are two sources of iron losses in the armature. These sources are: (1) the energy spent in continually reversing the magnetism in the armature core as the armature revolves. It is called *hysteresis.* (2) That used in setting up useless currents in the iron. It is called *eddy-current loss.*

In 1892, Dr. C. P. Steinmetz gave out the results of his experiments, showing that the power dissipated by hysteresis varies directly as the frequency of the reversals, directly as the total mass of iron, and as the 1.6 power of the magnetic density. This he expressed by the following empirical formula:

$$P_h = \eta B^{1.6} f V 10^{-7} \quad (19)$$

Where P_h = hysteresis loss in watts.
η = coefficient of hysteresis.
f = frequency in cycles per second.
V = volume of iron in cubic centimeters.
B = flux density in gausses.

The coefficient of hysteresis depends upon the physical and chemical qualities of the iron. For good armature iron it varies from 0.0012 to 0.0020 A fair value for good iron is 0.0015.

Reducing to practical units and inserting 0.0015 for η, we get,

$$P_c = \frac{1.25\, B_c^{1.6} f V_c}{10^{10}} \quad (20)$$

where P_c = hysteresis loss in the portion of the armature below the teeth.
B_c = magnetic density in maxwells per square inch.
V_c = volume in cubic inches.
f = frequency in cycles per second.

$$P_t = \frac{1.25\, B_t^{1.6} f V_t}{10^{10}} \quad (21)$$

where P_t = hysteresis loss in watts in the teeth.
B_t = average density in the teeth.
V_t = volume of the teeth.

$$P_a = P_c + P_t \quad (22)$$

where P_a = total hysteresis loss in the armature.

From his experiments Steinmetz also found that the energy consumed by eddy currents induced in a body of iron varies as the square of the magnetic density, as the square of the frequency and in direct proportion to the volume of iron. This he expressed by the following empirical formula:

$$P_e = \zeta B^2 f^2 V \quad (23)$$

where P_e = eddy-current loss in watts.
ζ = eddy-current constant, which depends upon the thickness and the specific electrical conductance of the material. For the numerical value of this constant Steinmetz gives the following formula;

$$\zeta = \frac{\pi^2}{6} d^2 Y 10^{-9} = 1.645\, d^2 Y 10^{-9} \quad (24)$$

where d = thickness of iron laminas in centimeters.
Y = electrical conductivity in mhos
= 100,000 for ordinary armature iron.

Inserting the value of ζ with reference to iron and reducing to practical units the following formula is obtained:

$$P'_c = \frac{2.7\, d^2 B_c^2 f^2 V_c}{10^{10}} \quad (25)$$

where P'_c = eddy-current loss in that portion of the armature below the teeth in watts.

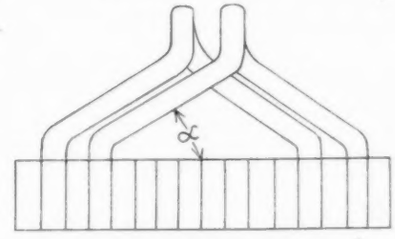


FIG. 2.—FROM ESTERLINE.
The angle a varies from 25 to 50 degrees; 30 degrees is a very good value.

d = thickness of iron laminations in inches.
B_c = magnetic density in the armature below the teeth in maxwells per square inch.
f = frequency of reversals, in cycles per second.
V = volume of core below the teeth in cubic inches.

$$P'_t = \frac{2.7\, d^2 B_t^2 f^2 V_t}{10^{10}} \quad (26)$$

where P'_t = eddy-current loss in the teeth in watts.
B_t = average density in the teeth.
V_t = volume of the teeth in cubic inches.

$$P'_A = P'_c + P'_t \quad (27)$$

where P'_A = total eddy-current loss in the armature.

$$P''_A = P_A + P'_A$$

where P_A'' = total loss in the armature.

The American Society for Testing Materials has made a number of experimental determinations of the core losses in various armatures and has published curves in its proceedings which show the relationship between the volume of the iron and the product of kilogausses and frequency.

(*I*) *Temperature Rise of the Armature.* The amount of the total energy consumed in an armature is

$$I_a^2 R_a + P''_A \quad (28)$$

The amount of heat liberated depends upon the area of its radiating surface, upon its circumferential velocity and upon the ratio of radiating area to the pole area.

As a result of a very elaborate series of tests made at Cornell University the following conclusions were drawn:[1]

1. An increase of the temperature of the armature causes an increased radiation of heat per degree rise in temperature, but the ratio of increase diminishes as the temperature increases, and an increase of the amount of heat generated in the armature increases the temperature of the armature, but less proportionately.

2. An increase in the peripheral velocity increases the amount of heat liberated per degree rise in temperature, but the ratio of increase becomes less with higher speeds.

3. The effect of the field poles is to prevent the radiation of heat.

Alfred E. Wiener, by combining these results with data and tests of various machines, found the values given in Table X.

TABLE X.
SPECIFIC TEMPERATURE RISE IN ARMATURES.

Peripheral velocity in feet per second.	Ratio of pole area to total radiating surface. 0.8	0.7	0.6	0.5	0.4	0.3
	Specific temperature rise per unit of power loss.					
0	110°	100°	95°	90°	86°	83°
10	80	74	70	67	64	62
20	64	61	58	56	54	52
30	55	53	51	49	48	46
40	50	48	47	46	45	44
50	48	47	46	45	44	43
75	47	46	45	44	43	42
100	46	45	44	43	42	41
150	45	44	43	42	41	40

The product of the specific temperature increase and the specific power loss gives the rise in temperature.

$$T_a = t_a \frac{E_A}{S_A} \quad (29)$$

where T_a = rise in temperature of armature in degrees centigrade.
t_a = specific temperature increase.
S_a = total radiating surface of armature in square inches.

1 Transactions American Institute of Electrical Engineers X, page 349.

E_A = total power loss in the armature.

E_A/S_A = specific power loss.

The radiating or cooling surface of an armature is that portion of its superficial area which is in direct contact with the surrounding air. The shape and construction of the armature and the size and arrangement of the field determine this radiating portion of the armature.

$$S_A = S + S_1 + S_2 + S_3 \quad (30)$$

where S = external cylindrical surface of the armature in square inches.

S_1 = internal cylindrical surface of the armature core in square inches.

S_2 = radiating surface of the core and conductors at the two ends of the armature.

S_3 = radiating surface presented by one side of a ventilating duct.

$$V_p = \frac{S V + S_1 V_1 + S_2 V_2 + S_3 V_3}{S + S_1 + S_2 + S_3} \quad (31)$$

where V_p = average peripheral velocity of the radiating surface of the armature.

V = peripheral velocity of S.

V_1 = peripheral velocity of S_1.

V_2 = peripheral velocity of S_2.

V_3 = peripheral velocity of S_3.

If the temperature rise does not come up to nearly the specified value, the current density in the armature inductors may be increased. If the temperature rise is too high it will be necessary to either increase the area of the armature inductors, or increase the radiating surface by putting in more air ducts, or by doing both.

The Standardization Committee of the American Institute of Electrical Engineers recommends that the maximum temperature elevation of the field and armature should be fifty degrees centigrade, of the commutator and brushes fifty-five degrees centigrade, and of the bearings and other parts of the machine forty degrees centigrade.

(*J*) *Commutator and Brushes.*

$$D_c = \frac{12\ V_c}{\pi\ r} \quad (32)$$

where D_c = diameter of commutator in inches.

V_c = peripheral velocity in feet per minute.

The peripheral velocity of the commutator should not exceed 3,500 feet per minute; about 2,200 feet per minute being a good average value.

On the other hand the diameter should be such that the segments will present a sufficient surface to the brushes and yet not be so wide as to require an excess of copper or brushes of unusual dimensions.

The number of segments to be used varies with the design and the style of winding used. The allowable difference of potential between the commutator segment is governed by the reactance voltage of the coils short-circuited, and varies from twenty volts or more in small 500-volt machines to two volts or less in very large 110-volt machines. Use 15 to 30 segments per pole for machines from 110 to 250 volts. Small four-pole 110-volt machines may have as few as 10 segments per pole. Use 30 to 45 segments per pole for 400- to 600-volt machines. Machines used for electrolytic work, where a large current at very low voltage is desired, often have only 6 to 10 segments per pole.

The voltage reactance of the coils short-circuited by a brush should not exceed two-thirds of the average voltage between segments. The insulation between the segments varies from 25 to 40 mils, that below the segments from 60 to 120 mils, and at the ends of the segments from 90 to 130 mils.

Assume that a brush will cover from two to four segments depending principally on which number will give you a good width of brush. Assume a current density of from 25 to 30 amperes per square inch of brush contact.

$$A_b = \frac{2\ I'_a}{\text{current density}} \quad (33)$$

$$L_b = \frac{A_b}{\text{width}} \quad (34)$$

where A_b = area one set of brushes.

L_b = length of one set of brushes.

Divide the above length up between a suitable number of brushes.

The length of the commutator will then be the length of the set of brushes plus a proper allowance for space between the brushes and for staggering.

(To be continued.)

Trains Dispatched by Telephone.

The Delaware, Lackawanna & Western Railroad has entirely dispensed with the telegraph for train dispatching purposes and has substituted the telephone for this purpose. The company has at present 271 stations equipped with telephone apparatus and has 2,500 miles of wire.

Trackless Trolleys in Sweden.

A concession has been granted to a local concern in Stockholm, Sweden, to operate a trackless-trolley system.

Cities Service Corporaton Organizes.

The Cities Service Corporation, which was incorporated in Delaware with a capital of $50,000,000, is to be the holding company for the Denver Gas and Electric Company, the Empire District Electric Company and the Spokane Gas and Fuel Company.

The capital is divided into $20,000,000 common and $30,000,000 of six-per-cent cumulative preferred. The common has been authorized to the full amount and will be exchanged for the shares of the three operating companies to the total of $5,000,000. Of the balance $500,000 has been set aside for corporate purposes, and the remaining $14,500,000 will be retained in the treasury.

Henry L. Doherty & Company, who are the bankers and syndicate managers of the merger, are to receive $500,000 in common stock of the new company for their services at this time and an additional $500,000 in ten-per-cent installments as the outstanding common stock is increased.

First Trains Out of Pennsylvania Tunnel Stopped.

Two of the first outgoing trains of the new Pennsylvania tunnel in Manhattan were delayed by an accident due to defective third-rail construction.

According to a report the workmen neglected to install a slanting rail so that the third-rail shoe might be picked up after passing over an op ning. Consequently when the shoes struck the ends of the rails they were ripped from their fastenings on the cars, leaving the train with no means of securing power.

Electrification in Russia.

London *Engineering* states that plans are being considered for the electrification of a portion of the Northwestern Railway in the environs of St. Petersburg. It is proposed to build a power station for the exploitation of the water power of the Wolchow, and the scheme comprises the construction of a high-voltage line for the transmission of the electric current for other purposes.

The government of Brazil has granted a franchise to the Brazilian Electric Power Company for the use of the water power of Tymbora, Gamelleira, and Bananeiras Falls.

CENTRAL-STATION PRACTICE

Transmission—Interior Wiring.

ELEMENTS OF POWER-STATION DESIGN.—III.

SELECTION OF STEAM BOILERS AND DESIGN OF BOILER ROOMS—II.

BY W. B. GUMP.

Mechanical Stokers.—The object of a mechanical stoker is twofold: (1) To save hand labor in firing. (2) To secure even firing, and resultant smokeless combustion. Few up-to-date power stations of over 1,000 boiler-horsepower are without mechanical stokers, since the advantages derived almost invariably offset the actual first cost, and operating expense.

In selecting a mechanical stoker the chief items to be included are: (*a*) Simplicity; (*b*) rigid construction; (*c*) accessibility for cleaning, inspection and repairs; (*d*) moderate cost.

The first reason for having mechanical stokers (that of supplanting hand labor) is so closely related to the second, that the two are practically inseparable. Smokeless combustion is a direct result of uniform firing, and since mechanical firing precludes the human element the chances for smoke production may be materially lessened. It has been found that plants in which hand labor is employed are the worst offenders in regard to the smoke nuisance. As the class of attendants employed in the average boiler room is such that their ambition to fire a battery of boilers efficiently is lacking, the argument is again presented that higher salaries in the boiler room will do a great deal to improve combustion, and contribute to smoke suppression generally.

One of the best forms of mechanical stokers is the chain-grate type. Its greatest advantages are simplicity of operation and ease in removing from the furnace. When properly installed this form of stoker gives splendid results.

Very little power is needed to operate mechanical stokers, as the coal is fed to the furnace very slowly. The usual method of driving the mechanism is by means of a shaft extending the length of a row of boilers, and operated by a belted connection either to a small steam engine or electric motor. Rather vigilant attention to the stokers is demanded, on account of the seriousness of an interruption in firing. A careful inspection of the entire mechanism several times a day is advisable, as a means of decreasing the possibilities of interruption.

Coal and Ash Handling.—In nearly all large power plants some form of fuel conveyor is installed. It would be out of place here to attempt to describe in detail the different types of conveyor, since the methods of handling vary according to the local conditions of the particular plant in question. The typical conveyor is a continuous belt or chain of buckets upon which the coal is fed from bins or dump cars and is carried to a point where it is automatically ejected into a hopper above the boilers.

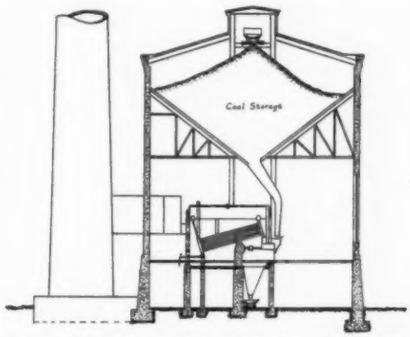


FIG. 1.—COAL AND ASH-HANDLING SYSTEM OF GOOD MODERN BOILER ROOM.

It is evident that the labor in handling fuel adds considerably to the fuel bill. Although mechanical conveyors can be substituted in place of a large force of labor, yet such apparatus demands several attendants in any case, and the cost of handling is not necessarily less than with hand labor exclusively. The greatest advantage is regularity of operation rather than the supplanting of hand labor. A force of labor such as would be employed for this work could scarcely be counted upon for reliability.

A certain number of men are required on account of keeping up the supply from which the conveyor is filled, as well as inspecting the apparatus and attending to breakdowns. During severe winter weather the coal is likely to become frozen in the cars, and when this occurs a large force of men is required to break up the coal preparatory to its being transported to the hoppers from which it is conveyed.

A combined coal and ash-handling conveyor system is shown in section in Fig. 1, which is a good general elevation of a modern boiler room.

Coal Storage.—Every steam power plant should be provided with a sufficient storage of fuel (whether it be coal, wood or oil) to insure continuous operation of the plant during seasons accompanied by transportation difficulties, such as heavy snowstorms, floods, or other emergencies. The duration of such emergencies cannot be foretold, to say nothing of the impossibility of predicting the nature of the trouble. It is safe to assume that interruptions in one form or another are bound to take place, unless some provision is made to prevent them. It is impossible to give any rule as to the storage capacity necessary in a plant, since no two plants face the same operating difficulties, but will vary widely as to local conditions. However, we may assume conservatively that the average steam plant should, when possible, be provided with a coal supply which will operate the plant for one month. This is not possible in many plants; hence an interruption to the coal supply may become an extremely serious matter. One of the largest steam power plants in New York City is provided with coal storage capacity to the amount of 150,000 tons. A shut-off in the supply of coal to such a plant

would be a matter so serious that the losses involved could scarcely be determined.

Arrangement of Boilers.—After the type of boiler and other preliminary factors are settled, a general layout must be made, showing the exact arrangement of boilers, giving the space occupied, the scheme of piping, the style of breeching, location of chimneys, the space available for fuel and for properly attending to the entire battery of boilers.

The matter of floor space is sometimes so important that a vertical type of boiler is chosen in preference to the horizontal type. The amount of headroom is increased when vertical boilers are used, but the total cost of the building may be greatly reduced notwithstanding. In large city plants the vertical type is seldom used; one reason is because the boilers can best be located above each other, and thus affect the desired saving in ground space. Where coal bunkers are built over the boilers, the vertical type is apt to demand undue headroom. However, in cases where it is desirable to locate the entire battery on one level, and other factors are favorable, the vertical type of boiler will usually offer considerable economy in ground area, and should reduce the cost of the building (as compared to the horizontal type), provided that the increase in overhead space is not productive of abnormal cost of flues, coal hoppers, piping, or brickwork. These items must always be taken into consideration before concluding that either type is superior to the other as regards cost. As to the question of efficiency, there should be no difference.

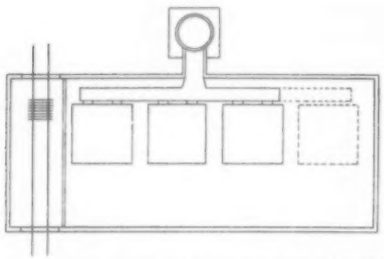


FIG. 2.—INSTALLATION OF THREE DOUBLE BOILER SETTINGS, AND SPACE FOR FOURTH.

One serious disadvantage of the vertical boiler is that the upper portion is more inaccessible than with the horizontal construction. It is therefore more inconvenient to inspect safety valves, or even to observe the gauge glass. It is also rather difficult to make pipe connections.

The location of breeching and flue connections must be governed mainly by the space required for apparatus such as piping, heaters, pumps or kindred appliances, and should be placed so as not to interfere with the operation of or accessibility to these appliances. Furthermore, the boiler settings and appurtenances should be so arranged that the operation of the entire boiler room is facilitated.

At the outset due consideration must be given to the question of future additions, and the general plan made accordingly. If this is overlooked, as it has been in many plants, the cost of making extensions is likely to become excessive and the operation during new installations seriously hindered. Incident to this it should be noted that the piping system demands careful planning if trouble is to be avoided when additions are made. It is safe to assume that a power station will at least double its capacity within one year after completing the first installation. That is, at the end of one year a new installation equal to the original plant will likely be needed, allowing a certain percentage of this capacity for reserve. With this plant as a working basis, the character of a boiler room is generally quite different from the design it might be were the question of extensions entirely avoided. After the plant has been in operation for a year the growth of the market is sufficiently well defined to give a clear idea of the extensions necessary.

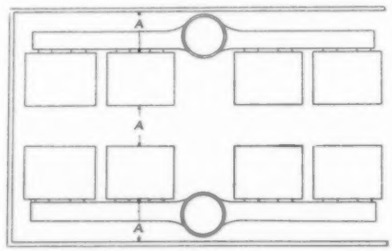


FIG. 3.—DOUBLE ROW OF BOILERS, IN EIGHT BATTERIES OF TWO EACH.

It is impossible to lay down fixed rules for the manner of grouping the boilers, as the factors in each case are chiefly local. When possible it is good practice to divide the boiler capacity into two or more equal groups; either in one long single row of boilers, with an aisle at one side, or two rows facing each other with the aisle between. In either arrangement due regard must be given to entrances to the engine room at convenient points. Fig. 2 shows an installation of three double settings, allowing space for an additional double setting as indicated in dotted lines. To the left is a track for bringing coal cars into the building and transferring the coal to conveyors which in turn deliver it to storage hoppers above. Here the chimney is symmetrical with the building but not with the boilers. This would be no great disadvantage unless several new settings became necessary, in which case a second chimney,

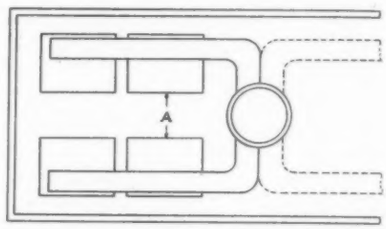


FIG. 4.—ONE CHIMNEY SERVING BATTERY OF BOILERS.

and probably a new building, would be needed. This layout is best adapted to the smaller and medium-sized plants, such as manufacturing plants, in which the extensions are not likely to be carried beyond the original building for a great many years. By the time such extensions are demanded the original equipment will probably be obsolete.

A double row of boilers is shown in Fig. 3 which is an arrangement quite common to the larger power stations. In this arrangement there are eight double settings, or eight batteries of two each. The capacity is divided equally, each half having its own chimney. It will be noted that the breeching extends behind the boiler setting and therefore requires extra ground space. In Fig. 4 is an arrangement showing boilers of exactly the same dimensions, but the entire battery having a single chimney, and the breeching carried above the boilers. Assuming that in Fig. 3 five additional feet in width are required behind each row of boilers, the total width of the building has been reduced ten feet, permitting the same aisle space, and the same space for piping or other apparatus behind the boilers as behind the breeching in the first arrangement, and this without an appreciable addition to the length. In this layout the chimney

must be larger than either of those shown in Fig. 3 in order to accommodate the entire battery of boilers.

From the operating standpoint the arrangement in Fig. 3 is preferable to that shown in Fig. 4, since the latter has the aisle separated into two parts which prevents a view of all of the boilers from one point. A modification of Fig. 3 could be had by placing the chimneys outside the building, thus affording an opportunity to decrease both the width and the length. If a steel stack were to be employed in Fig. 4, instead of brick or concrete, the chimney could be supported on steel columns, or upon the boiler structure, and allow a clear passage through the entire boiler room.

Chimneys.—Chimneys may be classified as: (*a*) Steel; (*b*) concrete; (*c*) masonry.

Steel chimneys are cheaper to build than either of the other two types, occupy less ground space than the masonry type, and have less surface exposed to the wind for a given internal diameter. They may be constructed with or without brick lining. The lining is preferred, however, on account of retaining the heat and also preventing deterioration. One disadvantage of steel chimneys is that they rust readily when not kept properly painted. This increases maintenance as compared to a chimney of concrete or masonry.

The advantages of a concrete chimney are: (*a*) Permanency; (*b*) small diameter required at base; (*c*) great strength; (*d*) adaptability to local requirements; (*e*) rapidity in building; (*f*) monolithic construction; (*g*) airtightness.

Brick chimneys, while used very extensively, have the disadvantages that they are (1) difficult to build, (2) less likely to remain airtight, (3) require a large ground space, (4) costly. Radial tile is being used to a large extent and has some advantages over brick. In an architectural way it is superior to brick, and may be made to present a better appearance than either brick or concrete.

As to a choice between the chimneys mentioned, it may be said that local surroundings will form the basis for a decision. The subject of chimneys is such a broad one that further discussion cannot be taken up here. In designing a plant one must look into existing designs which relate as nearly as possible to the operating conditions in view, and ascertain with what degree of success these designs have met the requirements.

Light and Ventilation.—The question of light and ventilation in boiler rooms is neglected in many plants, and this fact accounts in part for the indifference exhibited by those attending the boilers. There is no good reason why the boiler room should not have first-class ventilation. There are in some cases reasons for lack of light on account of special construction of hoppers, coal bunkers, conveyors, or other similar apparatus. When it is recalled that this portion of the plant demands constant attention, and that the shifts of men are of long duration, it is not surprising that these men are influenced by their environment, and, as a consequence, negligent operation follows. If boiler rooms were made more comfortable, the difference in the cost of making them so, as compared to that of mere engineering requirements, would doubtless be more than offset in efficient operation, to which cheerful surroundings contribute in no small way.

Cost of Boiler Installations.—Preliminary estimates on boiler equipments are generally based upon a certain fixed sum per boiler-horsepower. Since the price per boiler-horsepower will vary according to the capacity of the boiler, this method of computing the cost is not the most satisfactory. The ordinary return-tubular boiler is based upon twelve square feet of heating surface per boiler-horsepower. A Scotch marine boiler is reckoned at a lower figure. The former will cost roughly one dollar per square foot of heating surface in capacities above 100 horsepower, depending somewhat upon the locality in question.

Prof. C. H. Benjamin has given formulas for approximate costs of boilers, as follows:

For horizontal water-tube boilers, having ten square feet of heating surface per horsepower, steam pressure 125 pounds, cost in dollars=500+(9.2 ×horsepower).

For vertical water-tube boilers (same pressure and heating surface), cost in dollars=500+(8.5×horsepower).

For horizontal tubular, twelve square feet of heating surface, cost in dollars =100+(6.5×horsepower).

For small vertical fire-tube boilers, cost in dollars=100+(5×horsepower).

In each case the horsepower is understood to mean the normal rated horsepower. The costs are purchase prices, respectively, and do not include the setting.

For horizontal water-tube boilers:

Cost of setting=400+(0.8×horsepower).

For tubular boilers:

Cost=300+(0.7×horsepower).

(*To be continued.*)

Corrosion of Iron and Steel.

Steel, wrought iron and cast iron do not show notable differences in the attack of rust in still water, but such differences do appear in flowing water. Cast iron is then attacked more vigorously than wrought iron or steel. This is offset by the fact that in flowing water steel is attacked in a very irregular manner, so that in the same sample certain spots are attacked but little, while other spots are much corroded. With cast iron the attack is considerably more uniform. The degree of the attack by rust of steel and cast iron is dependent upon the speed of flow of the water. With increasing speed of flow the attack increases at first to decline again when the maximum is passed. In a strongly agitated solution of salt, the differences in the degree of attack of steel, wrought iron and cast iron decrease.—*Iron Age.*

Foreign Trade Opportunity.

An American consul in northern Europe reports that plans are being prepared for the enlargement of a municipal electric-power plant which was constructed a year ago at a cost of $431,375. The power is furnished by waterfalls fifty miles from the city. The plans provide for the eventual installation of machinery for generating 25,000 horsepower. Particulars may be obtained by writing to the Bureau of Manufactures, Washington, D. C., quoting File No. 5,442.

As showing the extent to which the use of rubber is rapidly increasing in the arts, it is interesting to note that the imports of crude indiarubber into the United States amounted to 101,300,000 pounds in the twelve months ended July 31, 1910. This is an increase of 15.07 per cent over the preceding twelve months.

ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

AN ARM FOR TUNGSTEN STREET LIGHTING.

A DESIGN OF SIMPLE CONSTRUCTION.

This arm can readily be made in the repair shop of any electric lighting company from materials and with tools that are always at hand. Figs. 1 and 2 show assemblies and indicate how the parts are arranged into the completed fixture. The arm is built from wrought-iron pipe, pipe fittings, strap-iron pieces and round iron rods.

It is arranged to hinge near the pole on a wrought-iron rod (Figs. 1 and 3) and is supported at its outer end by a length of galvanized arc-lamp chain so that its outer end can be lowered to the pole. The lamps can thus be easily cleaned and changed or adjustments made in the crimped-reflector fixture. The fixture (see Fig. 4) may be purchased from one of the several manufacturers that regularly supply this equipment.

The arm proper (Fig. 5 shows it before it is bent to form) is constructed from three lengths of galvanized-iron pipe, from pipe tees and a wrought-iron rod threaded at both ends. Dimensions of pipe sizes are not given, as they will be determined in each case by the length of the arm to be constructed. For ordinary conditions an arm ten feet in length, from pole to tips, will satisfy. One of this length made from three-quarter-inch pipe will be amply strong, and if weather conditions are favorable one-half-inch pipe might be used. For arms very much longer than ten feet, heavier pipe than three-quarter-inch should be used.

The three pieces of pipe, each threaded on both ends, are first made up with the fittings as shown in Fig. 5. The tees on the outer ends of the two long pieces are then drawn together over the ends of a short piece of unthreaded pipe, as shown by the end elevation in Fig. 4, and are secured in position by two pins, the ends of which are headed over, passing completely through the tees and the length of unthreaded pipe. A rod or "stem" threaded at each end should be inserted through the unthreaded length, so that the pins may also pass through it, and another tee should, at the same time, be placed on the length between the other two. The stem provides means for securing the insulator brackets (Fig. 1). The middle tee supports the tungsten fixture by means of a pipe nipple (Fig. 4). The middle tee is free to turn on the unthreaded pipe. In order that the three tees will slip on the unthreaded length, it will be necessary to use smaller size pipe for this than the tee size, or to turn out the threads of the tees on a lathe. The latter method will make the best job.

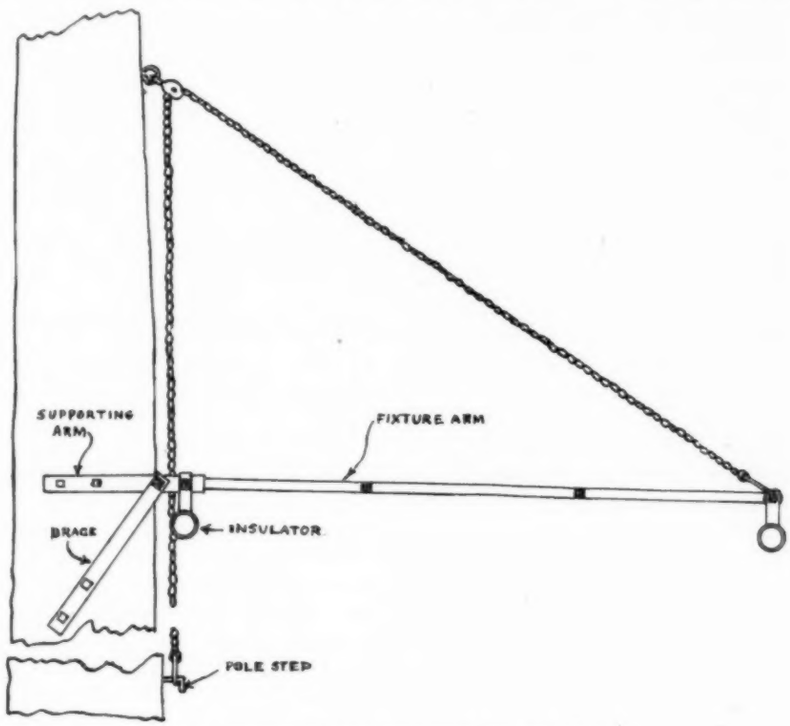


FIG. 1.—GENERAL ARRANGEMENT OF THE ARM.

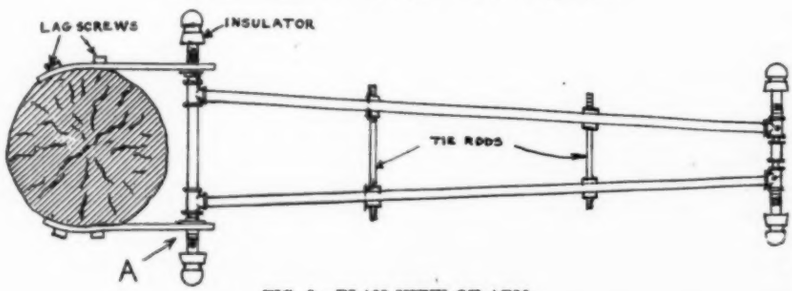


FIG. 2.—PLAN VIEW OF ARM.

Before the ends are forced together, it will be necessary to partially insert the tie-rods shown in Fig. 1. These rods can not be placed after the arm

ends are brought together unless they are threaded their entire length. It is better that they should not be so threaded. If deftly handled the tie rods can be made to assist in drawing the arm ends together by tightening the outer nuts on them. The two long pipes of the arm will have to be bent somewhat and fashioned to the form shown in Fig. 1, because the fittings tend to hold them in the position indicated in Fig. 5. But the bending can be done readily by holding the pole ends of the arm securely and using an iron rod as a lever successively in each of the tees at the other end. After the arm is fastened together the nuts on the tie rods should be set up snugly.

As shown in the assembly, Fig. 1, the brace and the supporting arm are made from strap-iron pieces. Cross-arm braces can, for a light arm, be used as material for these. Fig. 3 shows in detail the method of securing the supporting arm in position with nuts turning on the hinge rod. This rod should be sufficiently long so that the arm will turn easily on it and not bind on the nuts at either end adjacent to the tees on the arm.

Insulator brackets are arranged as outlined in Fig. 6. The bracket proper

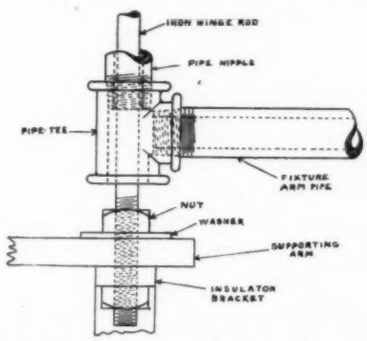


FIG. 3.—DETAILS OF PORTION *A* IN FIG. 2.

is bent from strap iron and has a hole drilled in it so that it can be fastened on either a hinge rod or a stem end. The insulator is fastened on with neat Portland cement. The end of the strap-iron piece is either roughened, as indicated under *A*, or a couple of holes are drilled in it, as shown under *B*, so that it cannot pull out. The cement should be mixed to the consistency of a thick paste and poured into the hole in the inverted insulator, around the iron piece. It should be kept wet while setting. At least two days should be allowed before a strain is permitted to come on the arrangement.

In tungsten fixture arms that are purchased from the regular manufacturers the insulators are usually furnished in a vertical position as shown at *C*, Fig. 6. But the horizontal position of *B* is preferable, because with it the wiring to the fixture can be more readily and mechanically installed. The conductors usually drop to the

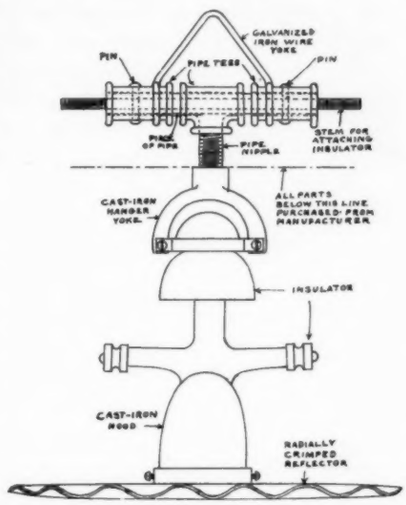


FIG. 4.—END OF ARM AND METHOD OF HANGING FIXTURE.

tungsten-lamp arm from a cross-arm above. With the insulator arranged horizontally, the wire can pass naturally around it and be terminated on a similarly arranged insulator at the end of the lamp arm. If the insulator, near the pole, is in a vertical position, the wire must be tied to it in an awkward manner. This sort of a tie is difficult to make and after it is made the line wire is apt to pull from the insulator.

Arc-lamp chain, formed from sheet steel and galvanized, makes the best support for the outer end of the arm. At this end the chain is fastened with a galvanized-wire yoke shown in Fig. 4. At the pole it passes through a galvanized-steel awning pulley held with a screw-eye. A ring is secured to the lower end of the chain (Fig. 1). This engages with a pole step. The arm can be lowered in much the same way as an arc lamp is lowered.

Tungsten Lighting in a State Prison.

A marked transition from the primitive lighting with candles to the thoroughly modern lighting with tungsten lamps was made on August 17 at the New Hampshire State Prison, in Concord, N. H. In this prison there are 186 cells, which have been equipped with four-candlepower low-voltage tungsten lamps. It was deemed desirable to use considerably less than the standard 110 volts in order to obviate any possibility of accidental or intentional shock to the prisoners. The wiring has been installed in a very substantial manner. Current is furnished by the Concord Electric Company at the same total cost as was formerly paid for candles. The company admits it is making a good profit from the installation. The lighting, however, is many times as bright, perfectly steady, absolutely safe, restful to the eye and costs no more than the primitive lighting formerly in use.

Improved Street Lighting in Crawfordsville.

The Commercial Club of Crawfordsville, Ind., is urging the installation of special street lighting with tungsten clusters on ornamental lamp-posts in the business section of the city. So much success has already been achieved with the preliminary plans that the carrying out of the project is assured. The new lamps will be placed about five to the block on each side of the street, about nine or ten blocks be-

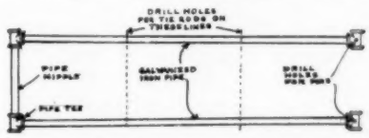


FIG. 5.—METHOD OF CONSTRUCTING ARM.

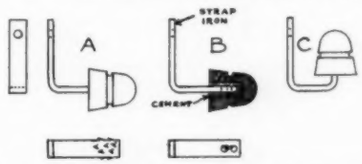


FIG. 6.—DETAILS OF INSULATOR BRACKETS.

ing equipped. The property-owners and merchants will pay for the initial installation, which will aggregate about $10,000, or less than $2.00 per front foot. The city will furnish the current and maintain the lamps.

The opening of the East River tunnels was marked by an increase of traffic of 15,000 a day between New York and Long Island. This increase in traffic will probably be maintained and a building up of Long Island is expected.

Additional ticket facilities have been provided at the Pennsylvania station and the traffic is being well handled.

Successful Use of High-candlepower Tungsten Street Lamps in Hartford, Conn.

The Hartford Electric Light Company was one of the first if not the earliest to make extensive use of series tungsten lamps for street lighting, and it again takes the lead with a large installation of high-candlepower lamps of this type on the streets.

Back in May, 1907, the town of West Hartford enjoyed the novel installation of some 200 sixty-candlepower, seventy-five-watt, 6.25-ampere tungsten lamps on its streets, and this work of the Hartford company attracted wide attention and comment at that time.

During the past year the Hartford company has been replacing its inclosed alternating arcs in that city with metallic-arc and tungsten-incandescent lamps on the streets. This change is now about complete and the company has no less than 1,676 series tungsten lamps rated at 100 candlepower and 125 watts each devoted to street lighting. Some 1,400 of these lamps are operated with 6.25 amperes and the remaining 276 with four amperes.

A number of tungsten lamps of lower candlepower that were formerly used for street lighting in Hartford have been replaced with the 125-watt size which is now employed exclusively for the incandescent installation on the streets of the city. The 125-watt lamps have also been extended into East Hartford to replace the alternating arcs on the streets of that town, and 206 of these lamps are operated there on twenty miles of circuits.

In Hartford the metallic-arc street lamps are located mainly in the business district, but also run out along several of the more important suburban avenues. Distances between these metallic-arc lamps are as small as 150 feet on parts of Main, State and Asylum Streets in the business center, and run up to as much as 400 feet in outlying sections.

The bulk of the street lighting in the outlying parts of Hartford is done with the 125-watt tungsten lamps, which are generally located 250 to 300 feet apart. An example of this lighting may be noted on Blue Hills Avenue, where in a length of 8,900 feet, or 1.7 miles, there are thirty-five of the 125-watt tungsten lamps, or one for each 254 feet of street. This distribution of the tungsten lamps calls for very nearly 0.5 watt per foot of street length. and gives a moderate illumination with only 2.6 kilowatts per mile.

As this installation of 1,476 tungsten series lamps operating with 125 watts each is perhaps the most extensive anywhere of so large a size, the average hours of life per lamp is of much interest because of its bearing on the cost of lamp renewals. Though the installation has not been in use long enough to determine the total average life of all the lamps, the following data as to lamps that have merely burned out are not without interest.

During a recent week fifty-five of the 125-watt series tungsten lamps, or perhaps four per cent of the number then in use, burned out. Owing to the gradual method of installation the tungsten lamps in use during the week in question had burned various numbers of hours each, and all these lamps were operating at the rate of about 4,000 hours per year.

During the week the fifty-five lamps that burned out had been in use from fifty to 1,498 hours each and had operated in the aggregate 44,347 lamp-hours. For these fifty-five lamps the average life was thus 806 hours. It is to be noted that this average is only for the burned-out lamps, which formed a small percentage of the total, so that the true average life for all the lamps will probably prove ultimately to be a much higher figure.

Further Extensions of Ornamental Street Lighting in New York.

The admiration with which the now numerous installations of special street lighting with ornamental tungsten clusters are being regarded is an exemplification of the saying that "imitation is the sincerest form of flattery." People come from near and far to see these installations and then go back and urge them in their own communities.

Instances of this tendency are coming to notice every day. A committee of business men from Mt. Vernon, N. Y., recently inspected the new lights on Main Street in Yonkers, and now is agitating a similar installation. The new street lighting in Syracuse has attracted so much favorable comment that its extension to several other streets is being seriously talked of. Visitors from several adjoining cities have also been impressed with the value of such lighting, and it is quite likely that other installations will follow. The tungsten-cluster lighting in Buffalo that was referred to in the last issue is also proving a model for other similar projects that are springing into being.

School of Gas and Electric Practice.

A recent issue of the *Progressive Age* describes the school of gas and electric practice which is conducted by the Denver Gas and Electric Company of Denver, Colo. It is the purpose of this school to give to the graduates of technical colleges such training as will enable them to become competent operators. In this it has been very successful.

Two years are allotted to the training, the pay given being sufficient to cover the student's expenses. During this time he does practical work in nearly every department and also attends lectures given by engineers and specialists in other lines. R. G. Griswold is secretary of the school.

Action of Hydrogen on Platinum and Nickel Wire.

When nickel and platinum are heated to a high temperature in a current of hydrogen they undergo a permanent change. The nickel shows an increase of electrical resistance, the platinum a lowering of the melting point and reduced ductility. This is apparently not due to the occlusion of hydrogen, but to the absorption of carbon from small quantities of accidental organic impurities carried by the gas.—*Zeitschrift fuer Elektrochemie*

Public Utility Merger in Brazil.

The Government of the State of Alagoas, Brazil, has granted the engineers Morales de los Rios and Luiz Oiticica a concession for the unification of the water, electric traction, drainage, telephone, and electric power services in the city of Maceio, as well as for a railway affording communication with the agricultural settlements the State intends to establish in its southern territory.

Copper Exports.

Copper exports for the week ended August 25 were 6,597 tons; since August 1, 24,345 tons, against 19,553 last year.

TELEGRAPHY—TELEPHONY, and WIRELESS.

TELEPHONE POLES AND POLE LINES.[1]

BY F. L. RHODES.[2]

Much work has been done in adapting the design of pole lines to the condition to be met, and this has required a study of the stresses on the poles, cross-arms, pins and wires under wind and sleet loads, and of the strength and durability of many different kinds of timber. In recent years the problem of prolonging the life of wooden poles and of obtaining some practical commercial substitute, such poles or reinforced concrete, has received much attention.

The most economical pole for use in each section of the country is that pole which will withstand the required load at the minimum annual cost. The load carried by a pole depends upon (a) the number and size of the wires, (b) the length of span, (c) climatic conditions as to wind velocity and the occurrence of sleet, (d) the natural shelter of the line by hills or forests.

The annual cost depends upon the first cost and the length of life. Into the first cost of the pole in place, enter the price at the woods as regulated by market conditions, the freight rate depending upon the weight of the timber and the distance from the point of supply, and the cost of teaming and erecting, which is also influenced by the weight. The length of life depends upon a variety of factors, the prncipal of which are the character of the timber and the local climatic conditions.

POLE TIMBERS.

Of the timbers used for poles, the white or eastern cedar, Idaho cedar, chestnut and the yellow pines are of the first importance; red cedar, juniper, cypress, catalpa, redwood and several varities of oak are used locally to a limited extent.

Throughout the New England and Middle Atlantic states chestnut is the principal pole timber, with, however, considerable use of cedar, particularly in Northen New England. In the South, yellow pine is the principal timber, with some use of chestnut, juniper and cypress. The yellow pine has to be creosoted. If this is not done, owing to the severe climatic conditions, not only the part near the ground line, but the whole length of the untreated pole will decay with great rapidity.

On the Pacific coast and in the Rocky Mountain states, Idaho cedar, Douglas fir and redwood poles are used. The redwood trees grow to great diameter, so that poles of this timber have to be sawed.

In the Central West, the Mississippi Valley and Prairie states, eastern cedar, Idaho cedar and yellow pine are the principal species in use. The selection is governed chiefly by railroad connections with the timber regions and by freight rates.

In the long-distance lines, out of all the poles in use, sixty-two per cent are cedar, thirty-one per cent chestnut, five per cent juniper and two per cent creosoted yellow pine.

The comparative strengths of the principal pole timbers are as follows, the figures representing fair average values for the fiber stress in pounds per square inch: Cedar, 3,600 pounds; chestnut, 5,000 pounds; yellow pine 6,000 pounds. From these figures it will be seen that, size for size, a chestnut pole is nearly 50 per cent stronger than a cedar pole, and that yellow pine is a trifle stronger than chestnut.

There is considerable difference in the weights of the different pole timbers. This has a direct bearing on the cost of transportation and distribution, and to some extent affects the cost of erecting. Chestnut and creosoted yellow pine poles weigh about twice as much as cedar poles of the same size. In the case of yellow pine, the treating process adds about a third more to the weight of the pole.

Different kinds of poles taper more or less rapidly, the average diameter taper being about one inch in six feet of length for cedar, one inch in seven feet length for chestnut, one inch in ten feet of length for Idaho cedar, one inch in ten feet of length for yellow pine.

Leaving out of account the compression load due to the weight of the wires, and considering only the horizontal load due to wind pressure on the poles and wires, a pole may be considered as a beam fixed at one end and loaded at a point at the center of the cross-arm system.

A large amount of mathematical work has been done in applying the theory of beams to poles. Owing to the taper, a pole is a beam of non-uniform breaking strength. The section where the breaking strength is theoretically less than at any other section is at the point where the diameter is one and one-half times the diameter at the center of the applied load.

Except in poles more than about thirty-five feet in height this section is at the ground line, and even in the case of very tall poles, the weakest section rapidly fals to the ground line on account to decay at that point. For poles of a given length and kind of timber, the breakng strength varies with the cube of the diameter at the breaking section. This fact serves to show why it is that stout poles are so very much stronger than slim poles.

Taking the strength of a pole ten inches in diameter as 1,000, the rate of increase in strength for each additional inch of diameter up to fifteen inches is shown by the following table:

Diameter, Inches.	Relative Strength.
10	1,000
11	1,330
12	1,730
13	2,200
14	2,740
15	2,380

This relation of the cube of the diameter also explains why it is that in

1 Abstract of a paper read before the New England Telephone Society.

2 Engineer, American Telephone and Telegraph Company, New York City.

cedar poles the effect of a limited diameter of hollow heart on the strength is but trifling.

Chestnut rots considerably faster than cedar. The results of measurements on more than a thousand poles indicate that the average annual decrease in diameter of sound wood is about 0.1 of an inch in cedar and about 0.15 of an inch in chestnut. The largest decay with chestnut poles is usually found from four to six inches below the ground line. With cedar poles the greatest decay usually occurs closely at the ground line.

POLE SPECIFICATIONS.

In formulating specifications it has been found convenient to divide poles into seven classes. These classes are designated by the letters of the alphabet from A to G inclusive. Classes A, B and C are respectively eight, seven and six inches minimum diameter at the tops. In addition to this requirement of top diameter, classes A, B and C have minimum requirements specified for the size at a point six feet from the butt, this being approximately the ground line when the pole is set.

A lot of unselected poles (termed the "wood's run"), all meeting a certain specified top diameter, are found to vary considerably in size at a point of six feet from the butt. For example, out of 180 six-inch-top, twenty-five-foot cedar poles measured at random, the diameter at the six-feet mark ranged from 7.6 inches to 12.4 inches. Ninety-five per cent of these poles, however, only ranged between 8.6 inches and 10.5 inches, or about one inch above and below the average. Out of a lot 320 six-inch-top, twenty-five and thirty-foot poles, almost exactly one-half were found to be below the class C requirement for size at the ground line.

It will thus be seen that classes A, B and C poles are selected poles, being approximately the stouter half of the "wood's run." The specifications for these higher-class poles are purposely so drawn in order that the poles of superior strength will be used in the heavier and more important lines. In general, class A poles are used for five, six, seven and eight-arm lines. Such heavy lines are occasionally made necessary where two toll routes join to enter cities where the difficulties of obtaining or holding rights of way make such heavy construction imperative. Class B poles are used for four-arm lines, and class C poles for two-arm lines.

Below class C the diameter at the base of the pole is not specified, the poles being purchased on top diameter alone, and the "wood's run" taken. Class D poles are six and seven inch for the taller poles. These class D poles are the portion of the "wood's run" which remains after the class B and class C poles have been picked out to meet the required size at the base. Classes E, F and G comprise six, five and four-inch-top poles that are used for lines of less than twenty-wire ultimate capacity, running down to the four-inch-top class G poles used for a single subscriber's bracket line.

Specification cedar poles, new, will carry about the following loads applied horizontally at the center of the cross-arm system: Class A poles, 3,100 pounds; class B poles, 2,300 pounds; class C poles, 1,500 pounds.

In exposed locations added strength is gained by using stouter poles, by replacing them at shorter periods, by setting more poles to the mile, by guying and bracing, and in some exceptional cases by using so-called A or H fixtures, constructed on two poles with cross-bracing.

PRESERVATIVE TREATMENT OF POLES.

Pole timber has been and is being cut with little if any regard to maintaining the supply on a permanent basis. Looking back over a period of twenty years, we find that pole prices have been steadily advancing. Roughly speaking, the prices of cedar poles doubled in the ten-year period from 1895 to 1905.

It is the increasing scarcity of timber which has brought the question of prolonging its life prominently to the front in this country. In Europe timber conditions forced the consideration of preservative methods long before the matter was taken up actively in this country. In the early days many schemes for preserving the butts of poles by charring, by coating with tar or asphalt or by setting in concrete were proposed and tried.

Experience has demonstrated that these expedients are entirely ineffectual and useless. It is now generally accepted that an effective timber preservative must be of an antiseptic nature, that it should penetrate the wood to a considerable depth below the surface, and that it must not wash out.

The decay of timber is caused by the activity of low forms of plant life, principally in the form of fungus threads, which produce ferments that exert a soluble action on the walls of the wood cells. These small organisms can grow either in light or in total darkness, but all of them require certain amounts of air, food, moisture and heat.

It is near the ground line, where the earth holds the moisture and keeps the wood damp for long periods in the presence of air, that decay is most rapid. Preservatives act antiseptically to kill the fungus growths that produce decay, and also to some extent by plugging up the pores of the wood, thus preventing the entrance of the moisture.

The dead oil of coal-tar or coal-tar creosote, which, according to the German statistics has by far the best record, is the preservative which has long been used in this country.

The usual method of applying this treatment requires a somewhat elaborate plant, the principal feature being the treating cylinder. This cylinder is sometimes 130 feet long and about seven feet in diameter. It is constructed like a steam-boiler shell, with both ends hinged so that they can be opened.

The timber to be treated is piled on small cars, which run on rails directly into the cylinder at one end. The cylinder is then tightly sealed and filled with steam. The timber is steamed for several hours, the length of time and temperature being regulated by the specifications. The steaming softens and opens the wood cells and liquifies the sappy constituents of the timber. After the steaming is discontinued a vacuum pump is applied to the cylinder. This draws the liquids out of the timber to a large extent. When the flow of liquid from the condenser during the application of the vacuum has ceased, the pumping is stopped, and the cylinder filled from a large measuring tank with dead oil of coal-tar.

When the cylinder is completely filled, pressure is applied to force the specified amount of oil into timber. After the oil pressure is released, the oil is pumped back into the measuring tank and the difference in the initial and final readings on a gauge attached to the measuring tank shows the amount of oil that has been absorbed by the timber.

As the portion of the pole at the ground line is the part which decays most rapidly, much attention has recently been given to methods for applying preservatives to the section of the pole extending from about a foot above the ground line to about two feet below the ground. The simplest way of doing this is to apply the preservatives like paint, with a brush.

This method was used to a considerable extent in some parts of this country from 1900 to 1905. The results did not in all cases prove beneficial. When the preservative was applied to poles that were seasoned, it appeared to postpone decay, whereas, when green poles were treated, no benefit resulted, and in some cases decay appeared to be hastened.

A line of experimentation which has been caried out in co-operation with the Forest Service has been the treatment of pole butts with dead oil of coal-tar by the open-tank process. With this method the butts of the poles are placed in tanks and covered with dead oil to a point about one foot above the ground line. The oil is then heated above the boiling point of water, either by means of steam pipes within the tank or by a fire built beneath it. This converts the water in the wood cells into steam, most of which escapes by bubbling through the oil. The air in the wood cells it also expanded and expelled.

After the pole has been thoroughly heated in this manner, the oil is either allowed to cool or the poles are transferred to another tank containing cold oil. In either case the effect is to form a partial vacuum in the wood cells, allowing the oil to be forced into the timber by atmospheric pressure. A considerable number of poles have been treated by this method. These poles are now under observation, and it is hoped before many years to have conclusive evidence as to the value of the treatment.

It has been shown that although the lighter distilling constituents of the oil tend slowly to escape from the portion of the pole above the ground, the composition of the oil in the portion of the pole at the grund line and below is pratically unchanged after ten years.

It is also a fact that creosoted wood poles are practically free from attack by woodpeckers. In some sections of the country, notably in the Eastern Central States, Texas, Arizona, and California the destruction of poles by woodpeckers is a serious matter. Some woodpecker holes are three or four inches in diameter and four or five inches deep. In some cases, they destroy the poles in only a few months, so weakening the pole that it may be dangerous for a lineman to climb it.

The economy of treating pole butts with preservatives is closely connected with another question, namely, that of extending the life of poles, which have become rotted at the ground, by some form of reinforcement. These have consisted in general of setting a stub of new timber close alongside the old pole and binding the pole and the stub together by means of twisted wire wrappings.

As a result of various tests three styles of stub reinforcement, differing from each other in the method of attaching the stub to the pole, have been adopted. The simplest form used for the lighter and less important lines makes use of the old plan of wire wrappings alone, although some improvements have been made in the method of applying the wrappings. For the more important lines, the wire wrappings are supplemented by two bolts extending through both pole and stub. Special tightening bolts are provided for the wire wrappings. In some portions of the country creosoted yellow-pine stubs promise the best economy. In other places there are found local timbers which, although not growing in the proper size for poles, may yet possess good strength and long life.

REINFORCED CONCRETE POLES.

The great advances in the use of reinforced concrete which have been made in recent years have set many people at work designing and building concrete poles. The results thus far obtained show that the poles are remarkably uniform in strength, and that their actual breaking loads are close to the computed values.

The poles are square in section and are hollow. They taper from twelve inches at the butt to six inches at the top. The walls are about two inches thick. Different amounts and kinds of steel reinforcements have been used. As a fair average of all the poles it can be said that the weight is about 2,000 pounds, of which about 300 pounds is steel and 1,700 pounds concrete. Cedar and chestnut poles of equal height and strength weigh about 500 and 1,000 pounds respectively. The poles will probably cost about $10 as against $5 for cedar poles. These figures do not take into account the costs of transportation and erection.

A considerable number of these poles will be made and erected, in order that experience may be had as to the effect upon them of stresses, vibrations, frost, lightning, and other actions of the elements. If, as there is every reason to expect, the prices of wooden poles continue to increase, a stronger case can be made out in the future for concrete poles than at the present time. So far as can now be seen, for a number of years to come, their use will be restricted to especially important lines and to permanently located poles in exchange work, such as poles for interior block distribution.

CROSS-ARMS.

At one time Norway pine was used almost exclusively for cross-arms. The cutting off of the Norway pine forests has, however, made the price of this timber so high that it is no longer used to any considerable extent for cross-arms. About ten years ago yellow pine was introduced as a cross-arm material. This wood in its natural state does not have the necessary life, and cross-arms of yellow pine are therefore treated with dead oil of coal-tar. At the present day these creosoted yellow pine cross-arms form a large portion of the total supply.

With the opening up of the Western forests, Douglas fir has entered into the field as a cross-arm material, and a large number of these arms are now being used. Other timbers are from time to time being investigated for use for cross-arms, and experimental installations of cross-arms of cypress and gum timber are now under observation. The strength of ten-pin creosoted pine standard cross-arms is such that they will sustain a downward load of about 250 to 300 pounds at each pin.

INSULATOR PINS.

Locust is pre-eminently the best wood for insulator pins. It is not only of high strength, but also of long life, and possesses the valuable property of high resistance to decay even when in contact with decayed wood. Locust suitable for pins does not grow in forests. Scattered specimens are encountered here and there, frequently in al-

most inaccessible places. Locust timber, therefore, is not cut by organized gangs, but by the farmers who have a few scattered trees on their land and who oftentimes cut the timber into billets which are accepted at the country stores in trade. In other cases, the farmers send their billets directly to the pin manufacturers. In either case the farmer cuts and delivers his billets only when he has nothing else to do.

Although steel insulator pins have been largely used in telegraph work, they have not commended themselves for use in telephone construction. Locust pins have an average breaking strength of about 1,200 pounds. The usual form of steel pin bends under a load of about 700 pounds. Moreover, steel pins cost from two to three times as much as wooden pins, are more expensive to place in the arms, and have a shorter length of life.

LINE WIRE.

Iron wire is used in many sections of the country for exchange lines, center-checking lines, and for short and comparatively unimportant toll lines. In the Central and Rocky Mountain states iron wire has usually a life of from ten to twenty years, and there are some exceptionally dry sections where still longer life is obtainable. Iron wire of the grade that is usually employed has a tensile strength of about 55,000 pounds to the square inch and elongates about twelve to fifteen per cent of its length before breaking.

The hard-drawn copper wire, which constitutes the bulk of the wire plant, has a tensile strength of from 62,000 to 65,000 pounds per square inch, and will elongate about one per cent of its length before breaking.

On account of the fact that wires expand at high temperatures and contract at low temperatures, the temperature has to be taken into account in stringing wires. If wires strung in the summer are stretched too tightly, they are liable to break in winter as the result of contraction. Aside from the temperature effects the actions which occur in a span of wire under load are very complicated. For a span of given length the stress in the wire diminishes as the sag increases. Owing to the elasticity of the wire, when it is subjected to load, as by sleet, it stretches. The increase in length due to this stretch allows it to sag more than before. This increase in the sag tends to relieve the load. A condition of equilibrium is therefore reached where all the stresses are balanced.

The behavior of the wire under any given conditions can be very accurately computed. For the ordinary span of 130 feet the specified sag at sixty degrees Fahrenheit is seven inches. Due to contraction this decreases to about four inches at zero Fahrenheit. The stretch of one per cent is sufficient to allow the sag to increase to six or seven feet before the wire breaks. The specified sags are such that the wires under the loads due to wind pressure and sleet have about the same factor of safety as the pole lines.

Telephone Profits in France.

TO THE EDITOR:

The articles on "The History of the Telephone," by Mr. Herbert N. Casson, now appearing in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, must greatly interest all telephone men.

I notice in the article on "The Telephone in Foreign Countries," which appeared in your issue for August 6, it is stated that the French government clears a net profit of $3,000,000 from its telephone monopoly. This, I think, is an inaccurate statement, and it seems to me likely that the author of the articles has made some confusion in his figures.

As a matter of fact, the French Department of Public Works, which controls the Postal Department, keeps no separate accounts for posts, telegraphs and telephones, but lumps the three services together. It is one of the grievances of the Association of Telephone Subscribers in Paris, which has done so much during the past five years to bring the causes of the inefficiency of the French telephone service into the light of day, that the accounts of the telephone service are not kept separate from those of the post and telegraph, so that the public might know the real financial results of the telephone department. As matters are now it is a standing reproach, reiterated almost every year by the Reporter of the Budget of Posts, Telegraph and Telephones, that the French administration does not know what the telephone system of France has cost, what it brings in or how much it costs to operate.

The figures given by Mr. Casson as representing the annual profits of the telephone monopoly in France I think are exaggerated. Indeed, as government administration is usually everywhere more costly than commercial management, I should imagine that there is no real profit on the telephone service in France. However that may be, the authentic figures for the total revenue and expenditure of the entire French Department of Posts, Telegraphs and Telephones for the last year for which the accounts are available are: Gross receipts, $69,183,200, and total expenditure, $63,501,200, leaving a balance of revenue over expenditure for the combined three services of $5,682,000. As in the large European countries, the postal service is by far the most profitable part of the business and the telegraphs and telephones are usually run at a loss, I think it is unlikely that three-fifths of the annual surplus of the French Post Office can be attributed to the telephone.

HERBERT LAWS WEBB.

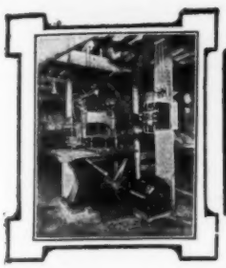
London, August 18, 1910.

Telegraph Rates Reduced.

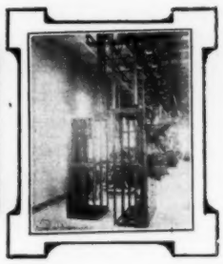
The Italian Government recently enacted a law reducing telegraph rates, which were much higher than the rates of other European countries. The new law goes into effect on December 1 and will provide for rates as follows: Ordinary telegram, minimum ten words, sixty centesimi ($0.115), with $0.01 for each additional word; urgent telegrams (former rate three times that for ordinary message), 1.8 lire ($.347), with $0.03 for each additional word above ten. The rates for ordinary and urgent telegraphic money orders are respectively the same as above. Ordinary telegrams directed to newspapers or press agencies from 9 p. m. to 6 a. m. are charged $0.115 for twenty words and $0.01 for each additional two words.

Free Telephones for Prisoners.

The telephone has, through a recent order of Police Commissioner Baker, of New York, removed one source of petty police graft. By this order each prisoner is permitted to call up three numbers in the city limits in his search for help. Formerly the prisoner was allowed to communicate only at the discretion of the officers and was often charged good fees for pen and ink or messenger service.



Industrial Power



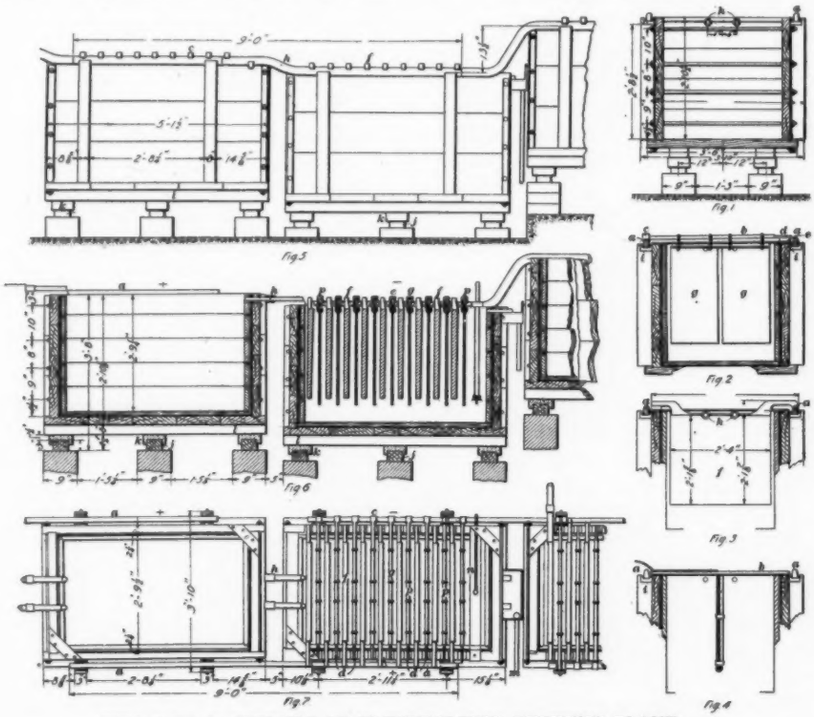
ELECTROLYTIC REFINING OF COPPER.[1]

BY G. H. BLAKEMORE.

The credit of establishing the first plant for the treatment of auro-argentiferous copper in New South Wales belongs to the Great Cobar Syndicate, which erected a plant nine or ten years ago.

The works at Lithgow include six tandem engines, each developing about 100 electrical horsepower. These belt-drive six shunt-wound four-pole dynamos each of sixty volts and 1,200 amperes at 350 revolutions, and one dynamo of twenty-five volts and 600 amperes at 450 revolutions. Steam power is supplied from multitubular boilers at a pressure of 120 pounds per square inch.

The plant is not at all modern or up-to-date in its machinery, and it will no doubt be replaced before long with a plant capable of supplying a greater amperage per square foot of cathode surface than is at present commercially attainable. With water costing but eight cents per 1,000 (British) gallons delivered at the works, and coal for $0.68 to $0.75 per ton in the boiler coal-bins, there is not any great saving to be made in the coal and water bills, even with high-grade engines fitted with the latest thing in condensers. Where the saving is to be made is in increasing the amperage to get a greater output of copper per tank, and so materially reduce the stocks of copper in course of treatment and, consequently, the costs for interest.



FIGS. 1 TO 7.—DETAILS OF ELECTROLYTIC REFINING PLANT.

The six large dynamos deposit copper from copper anodes; the small one, using insoluble lead anodes, takes the excess copper from the solution or electrolyte, as no bluestone to any extent is made in the works.

Three of the large dynamos have ninety-six tanks or depositing vats connected, and three have 128 tanks each. All the dynamos could carry 144 tanks each. The size of the tanks and system of insulation and circulation are shown in the accompanying figures.

The electrical connections are copper bars *a* (Fig. 1), cast on the premises, of a section about four square inches. They are much too large, but they were made so purposely to insure that no undue resistance occurred in the connections. The cross connections, *b* (Fig. 2), from the positive bars and negative bars are made at the works, and consist of a copper head *c* being cast on a seven-eighths-inch copper pipe, long enough to give contact for the cathodes or anodes. Strength to carry the weight is obtained by a five-eighths iron bar *d* inserted into the pipe. The iron bar is long enough to project out of the copper pipe a few inches, so as to rest on a glass block *e* on the wall of the vat. Theoretically speaking, one square inch of cross-section in a copper lead is supposed to be large enough to convey 1,000 amperes of current.

Each vat carries nine large anodes *f* (Fig. 3), and nine cathode bars with two cathodes *g* (Fig. 2), on each. The vats are made of Oregon pine, the separate bodies being dipped for about ten minutes in boiling paraffin wax of a melting point of 140 degrees Fahrenheit. They are lined with lead sheet of six pounds to the square foot, the lining being brought over the top edge of the tank to preserve the wood from the attack of the strongly acid electrolyte. The fall of level between tanks is three inches, the liquor or electrolyte flowing from one tank to the other in cascade fashion. The electrolyte escapes from one tank to the other through a compound pipe *h*, the first part of which is lead, burnt on the lining of the delivery tank and projecting beyond the wall of the tank sufficiently

1 Abstract from the Proceedings of the Australasian Institute of Mining Engineers, February, 1910.

far to allow of joining on a piece of good quality rubber hose, which, at the other end, takes a glass tube of about one inch internal diameter. To a certain extent the leakage of current from tank to tank is thus stopped by the glass pipe acting as an insulator.

The first secret of electrolytic refining is efficient insulation. It is also the most important. The tanks must be efficiently insulated from one another as described above. The conductors are insulated from the tanks by their resting in glazed porcelain holders *i* held in brackets on the outside walls of the tanks. From the earth the tanks or vats are insulated in the following way: Six brick piers are built up to the height required; on them rest square blocks *j* (Fig. 5), of Oregon pine treated with boiling paraffin wax, and fitting on these blocks are square glass drip insulators *k* of the type used in storage batteries. On the top of each row of three piers, finished as described, is laid a piece of hardwood *l* treated with paraffin, making a seating for the tank, which rests directly on the wooden joists. The vat or tank can be got at on all sides and the bottom, and if any leak of electrolyte occurs it can be readily seen and the tank removed for repairs. Cleanliness is the next secret. All connections must be kept clean and bright. A little emery cloth in the hands of interested employees will attend to this part of the process.

The electrolyte flows from one tank to another in each row until at each eighth tank the overflow delivers into the sump launder *m* (Fig. 7), which returns the escaped electrolyte back to the collecting tanks, from whence it is elevated by compressed air to sand filters. These in turn deliver it to feed tanks, supplying fresh electrolyte to all rows of tanks. Every eight tanks, therefore, in each row of tanks have their own supply of electrolyte. This is done with a view of equalizing the temperature of the electrolyte. The flow of electrolyte to the leading tank in each series of eight tanks is approximately one and one-half gallons per minute.

The sand filter mentioned is for removing the small quantity of slime carrying silver and gold, which is in suspension.

The average of nine assays of the electrolyte before and after filtering it is as follows: Before filtering, grains per gallon: Gold, 0.023; silver, 0.159. After filtering, grains per gallon: Gold, 0.0009; silver, 0.0071.

The third secret is the temperature of the electrolyte; the lower the temperature the greater the resistance to the passing of the electrical current. The height of temperature is limited according to circumstances of construction of tanks. At Lithgow it is about 120 to 130 degrees Fahrenheit. This temperature is obtained by passing waste steam through hard-lead coils, which are placed in the supply tanks. It is quite easy to maintain a regular temperature. Besides materially reducing the resistance offered to the passage of the electrical current, the increased temperature causes a more even deposit of copper on the cathode, especially where the free acid content of the electrolyte is above eight per cent. With the electrolyte at, say, eighty degrees Fahrenheit, and eight per cent free acid, the face of the cathode would in a few hours be covered with a growth of copper in hairlike form, projecting in all directions in the electrolyte, the almost immediate consequence being a large number of short-circuits between each anode and cathode. If the temperature is low the acid contents must be lowered to avoid this occurrence, so that the resistance of the cool electrolyte is made still greater by reducing the acid contents. Theoretically speaking, hot liquors redissolve some copper. Tests made and reported by Gore show that in a cold liquor more copper is deposited than in a hot one, but the writer is absolutely satisfied that the tests given by Gore on page 124 of his book, on hot and cold acidified solution of pure cupric sulphate, are incorrect, or made under wrong premises, for if he or anyone else could recover from a cold solution seventy-five per cent more copper than from a hot one, then the present accepted figures of electrochemical equivalents would have to be recalculated. With a strongly acid electrolyte a high temperature is an absolute necessity, and whatever the loss of copper by resolution may be, it is more than paid for by the great reduction in resistance to the current and consequent larger output of copper than from a cold solution. The writer does not think that the form of the experiments quoted by Gore, and made with hot and cold solutions, is one that will give correct information. Gore takes the metal and sees what the loss is in a cold acidified solution, and what it is in a hot acidified solution, and the results quoted are apt to mislead people. The factor of an electric current passing in a hot solution makes all the difference. At Lithgow, by raising the acid contents of the electrolyte and the temperature and seeing to the insulation, the plant can now turn out 150 tons of electrolytic copper per week. With low acid and cold solution the same plant never exceeds eighty tons of output per week. The theoretical output of the plant, according to Gore's formula, is as follows:

Deposited per ampere-hour, 18.1164 grains copper.

Dynamo, 60 volts and 1,200 amperes. Therefore 1,200 amperes $\times$ 18.1164 = 21,739,680 grains = 3.1056 pounds $\times$ 24 hours = 74.534 pounds per tank for 24 hours; 288 + 384 tanks = 672 tanks $\times$ 74.534 pounds $\times$ 7 days = 156 tons per week, theoretical output.

Geipel and Kilgour's formula is:

$$\frac{168 \text{ hours} \times 1{,}200 \text{ amperes} \times 2.596 \text{ lbs.}}{1{,}000}$$

Answer multiplied by tanks = output, 157 tons.

Hence, if the theoretical output for 672 tanks, not allowing anything for electrical loss, is 150 tons, and the possible output is 157 tons, it is quite clear that Gore's tests, showing seventy-five per cent depositing increase for cold solutions over hot solutions are woefully wrong. It may be a misprint, but in the absence of an extensive literature on electrolytic refining a person who is groping his way along hesitates to try hot solutions in the face of such apparently positive proofs as to the low efficiency obtained from hot solutions. Since hot solutions have been used the resistance drop per tank has become less than 0.40 volt, so that although the present tanks number 672 it would be easily possible to use 864 tanks, and in that case the output of the plant would be about 200 tons of electrolytic copper per week. These figures demonstrate the very great importance of high temperature and high free acid in the electrolyte. The two things are so dependent on the existence of each other that one hardly knows which to attach the most importance to, viz.: high temperature or high acid. One thing can be said, viz.: that the limit of free acid contents is reached at about fourteen to fifteen per cent, but the writer does not know what is the limit of temperature. Up to 135 degrees Farenheit has been used at Lithgow with excellent

effect. If it could be arranged the writer would work with much hotter solutions than 120 degrees Fahrenheit; in fact, to as high a point below actual ebullition as could be got, but difficulties, such as ventilation of rooms and construction of tanks would have to be overcome. These are easy in a new construction, but not in old buildings. Strong convection currents might prevent temperatures much higher than 150 to 160 degrees Fahrenheit being used, for such currents might prevent the slime settling down properly and lead to gold and silver losses in the cathodes.

A further important effect of the hot electrolyte is that the slime containing the gold and silver with the insoluble impurities contains much less copper. This effect is also assisted by a high percentage of free sulphuric acid in the electrolyte; still, the chief element of importance is a hot electrolyte. The following experiments will show clearly the importance of heating the liquor to bring about a reduction of the copper in the slime.

The test was made on one series of eight tanks. No. 1 tank was fed with electrolyte at a temperature of 120 degrees Fahrenheit. The electrolyte overflowed from that tank through No. 2, successively, down to No. 8. The escaping electrolyte at No. 8 showed a temperature of ninety degrees Fahrenheit. The fall of temperature was therefore thirty degrees. The eight tanks were run for several weeks and then the mud in each was analyzed, with the following results:

	Copper Per Cent	Gold Per Cent	Silver Per Cent
No. 1 tank	22.75	4.665	27.835
No. 2 tank	22.75	4.550	26.500
No. 3 tank	36.00	2.910	18.510
No. 4 tank	40.00	2.830	17.770
No. 5 tank	63.10	1.550	9.050
No. 6 tank	66.10	1.035	6.835
No. 7 tank	70.30	.905	5.545
No. 8 tank	72.40	.850	5.400

These figures forcibly demonstrate the fact that a properly constructed electrolytic refinery should have hot electrolyte fed into every tank, or at least into every two tanks. Although the anodes were the same value in all the tanks, note the difference in value between the slimes in No. 1 and No. 8 tanks due entirely to the difference of temperature in the electrolyte. Each vat is separately agitated by a jet of compressed air at the low pressure of five pounds per square inch, by means of a small air pump *n* (Fig. 7), made out of three-quarters-inch lead pipe, reaching to within six inches of the bottom. The detail is shown in Fig. 4. The air is led to the bottom of the pump by means of a one-quarter-inch diameter composition gas pipe. The end of this one-quarter-inch pipe is turned up so as to discharge the air upwards into a three-quarters-inch lead pipe. The expansion of the air lifts the liquor as in a Pohle air lift, and discharges it at the surface, doing two things in one operation, viz.: aerating the electrolyte and mixing it. If no agitator of this type is used the electrolyte has the marked tendency to separate into two layers, the lower one being heavy in sulphate of copper and low in free acid and the top layer high in free acid and low in sulphate of copper. The damage done by this state of affairs is, first, the bottom layer may get so strong as to crystalize out bluestone; and, secondly, at the junction of the two layers of liquor the anodes especially will be cut in halves by the more intense action of the top acid liquor; or, if this does not happen, the copper in the top half of the cathode is gradually dissolved away, whilst the lower half of the cathode becomes rapidly thicker. When this is happening, and the lower half of the electrolyte commences to crystalize out bluestone, the workmen may easily have an opportunity of seeing some electrical fireworks from a heavy short-circuit. Such things do not happen in properly constructed or properly cared-for plants, but there are places where they have occurred. Where tanks have been standing for some days waiting to be charged with anodes this separation of liquid sometimes occurs, and, even though the air agitation is started at once, the pipe being small, it takes time to mix a separated solution. In such tanks after the current is connected one will occasionally find the solution boiling, but a water hose put into the bottom of the tank for a few minutes will stir up the heavy solution and stop the boiling in the tank. The aeration of the liquid tends to oxidize some of the impurities, such as antimony, which gather in the electrolyte.

The next secret of importance is the composition of the electrolyte. At Lithgow approximately the following composition was used:

Free sulphuric acid, twelve per cent. Bluestone, fourteen per cent. Specific gravity, 1.18 per cent.

As before stated, low acid increases the resistance of the electrolyte, and the copper deposited on the cathode, instead of being all metallic, is a mixture of metallic copper and cuprous oxide, whilst a large amount of oxide of copper precipitates with the gold and silver slime. The gold and silver mud consequently may contain as much as eighty per cent of copper, whilst the cathode copper is brittle from the presence of oxide of copper. Instead of its color being bright pink it will be dark brown, especially after being in the air a short time. This action will commence if the acid falls below about 3.5 per cent in the electrolyte. The conductivity of such a cathode is low; in fact, a low percentage of free acid produces copper of inferior quality, for there is not enough acid present to keep the impurities from redepositing. If the acid is too high, polarization troubles are set up. The author has found that a free-acid content of about twelve or thirteen per cent was safe, and good work was obtained with the amperage he worked at, which was from twelve to fourteen amperes per square foot of cathode surface.

The rough or blister copper is first of all refined in reverberatory furnaces to bring it up to about 99.4 to 99.6 per cent of copper; its gold contents may vary from two to four ounces and the silver from fifteen to twenty ounces. It is cast into anodes of the shape and size shown in Fig. 3. The weight of the anode which is used for straight-out electrolysis is about 200 pounds, and the anodes used for making skins or starting sheets weigh 300 pounds. Having the tanks or vats all filled with hot electrolyte, the first thing done is to hang in each tank nine anodes with one lug resting on the positive lead and the other on a glass block. There are two cathode sheets between each anode, or eighteen starting sheets in a tank. The two sheets were called one cathode. The size of each sheet is roughly two feet two and one-half inches long by twelve and one-half inches wide, about 4.6 square feet of surface for one sheet, or 9.2 square feet of surface for each double cathode. If the dynamo is running up to 1,200 amperes and there are nine cathodes in each vat, then 9 cathodes $\times$ 9.2 square feet = 82.8 square feet of cathode surface, and the amperes per square foot of cathode surface are 1,200 $\div$ 82.8 = 14.5 amperes. As high as twenty-two amperes per square foot have been used, but with a small initial amperage of 1,200 it meant reducing the cathode

surface to about six double cathodes per tank, and if six cathodes were used, then when cathodes had to be removed it was quite possible the men might take out too many at once. For instance, if two were taken out the amperage would have run up to thirty amperes per square foot on the four left in. Such a high amperage caused very rough deposition of copper and required considerably more attention to avoid short-circuits of a dangerous character. It is a case of cost of attention versus cost of interest on copper tied up in the tanks. With the high amperage more risks have to be taken with redeposition of impurities. About twenty amperes per square foot is a nice working current, and the alteration of the plant to get this amperage will no doubt be done in the near future. The space between the face of each skin or starting sheet and the anode is two and one-quarter inches (Figs. 6 and 7). The skins are slung by copper hooks *p* on to the cathode bar, one end of which rests on the negative lead and the other end on a glass block standing on the wall of the tank. When sixty tanks are filled in this manner the engine is started slowly. If put at full speed too soon the current may easily buckle the thin starting sheets. In a few days these have increased in thickness by copper deposited, and the engine can be speeded up. More tanks are added until the full complement of vats is connected. The system of tank arrangement used is the multiple. It is arranged that all the cathodes are withdrawn from the vats or tanks during fourteen days time. This is done to avoid short-circuits, practice having shown that by removing a regular number of cathodes daily, the cathodes are removed before the nobby excrescences grow large enough to touch the anodes and cause loss of current by short-circuits. A short-circuit can usually be found by touch on an anode or a cathode, and there is little danger of shock with low-voltage dynamos. Occasionally, if gross neglect has occurred, the anode or cathode will be hot enough to blister the skin, but if one is observant, the dark color of the head of the cathode connection will indicate that it is too hot to touch. The anode must clear the lead sheet lining of the tank by about one inch; the bottom edge of the anode is about six inches from the bottom of the tank. The cathode starting sheets or skins are a little longer than the anodes, to avoid cutting off the lower part of the anodes by the action of the current. If the connections are kept clean and the cathodes are removed regularly in even numbers each day, so as to insure the whole being removed in fourteen days, they grow evenly, the anode is dissolved evenly, and short-circuits are not common. It is to be noted that all these remarks refer to the plant being described; conditions of work must vary with different voltages, amperages and equipment. Improvements in a great many directions could be made if the opportunity of a new plant ever arose. Higher amperages would compel the removal of the cathodes oftener than once in fourteen days, or a different system of removing them and higher voltages would prevent rough and ready methods of finding short-circuits with the touch of the hand.

In about three weeks the anodes are eaten out so thin that the remnant has to be removed. As they begin to be attacked the insoluble impurities in the copper, which are mostly gold, silver, selenium, etc., show on the face of the anode as a dark greenish slime, which slides off at irregular intervals to the bottom of the tank. Iron goes into solution. With the mud goes a certain amount of copper in the shape of very fine particles, together with scrap copper from the anodes. The presence of this mud on the faces of the anode tends to increase the resistance to the current, so that a newly charged tank will show a much higher voltage in a week than it did at starting. There is no profitable way by which this can be avoided. If the anodes were scrubbed daily it would mean extra labor and also fouling the electrolyte in the tank with fine particles of the mud, which in turn, would get more or less enmeshed in the rough, warty faces of the cathodes and so cause losses of gold and silver in the electrolytic copper.

The mud is taken from the tanks at regular intervals. In large works it is found to be advantageous to run the contents of the tank to be cleansed straight to a sump, and filter out the slime or mud. At Lithgow the top layer of clear liquor is siphoned off, the mud recovered by baling it out into a lead-lined box on wheels, which was taken to the mud-refining room, hoisted off the wheels and poured into the storage tanks through a copper sieve to remove the coarse particles of copper. These are well washed to reduce the mud clinging to them, and this so-called "mud scrap" is returned at intervals to a reverberatory furnace and remelted in separate charges to "mud-scrap anodes" in distinction to "scrap anodes," or "ordinary anodes." They are returned again to the electrolytic plant for separation. The percentage of all the scrap made from the depositing tanks totals from eight and one-half to nine and one-half per cent of the weight of the anodes treated. In most American works the percentage is from twelve to fifteen, because they work on the system of removing all the anodes at one time.

The mud, after sieving, is washed fairly free from sulphate of copper, slowly dried in steel-plate trays, then heated to a dull red to get rid of the tallow, which had originally adhered to the starting skins, and also to alter the mechanical condition of the graphite, which has also come from the starting sheets. Before the practice of heating the mud was adopted it was found impossible to get the copper out of the mud except after days of boilings with sulphuric acid, and even then as much as forty per cent of the copper remained in the residue. It might be added that this high percentage of copper only existed some years ago, before it was decided to keep the free acid contents of the electrolyte above ten per cent. Since the temperature of the electrolyte has been raised and kept at a regular point and the acid content increased, the copper in the mud has fallen from above fifty-five per cent to as low as 15.5 per cent.

The mud usually gives an assay of about twenty-four to twenty-eight per cent copper, which is not in the form of sulphate and has to be dissolved out with sulphuric acid. After heating the mud about 400 pounds of it are boiled with 300 pounds of concentrated sulphuric acid of 1.830 specific gravity in a cast-iron pan covered with a hood. In about four hours the copper is dissolved to as low as 0.3 per cent. The residue is then washed, dried and fused in a small cupel furnace with carbonate of soda to Dore bullion, which usually assays about twelve to sixteen per cent gold and eighty-two to eighty-six per cent silver.

The total cost to treat the mud, calculated per ounce of bullion produced, is about 4.42 cents.

SYNCHRONOUS MOTORS.—Does changing the field current of a synchronous motor change its speed? If not, how can the speed be changed? If the field circuit is suddenly broken, will the motor stop?—S. M. H., Belvidere, Ill.

Changing the field current of a synchronous motor does not affect its speed, because the latter is constant and is dependent only on the frequency of the circuit and the number of poles of the motor. Variation of field current does, however, affect the phase relation of the electromotive force and current supplied; strengthening the field causes a lagging current to be brought into phase and even to lead the electromotive force. It is not practicable to change the speed of a synchronous motor while operating, because to do so would require changing the frequency of the entire circuit; the speed can be changed by an inverse change in the number of poles, but this requires reconstruction of the field. If the motor has no load, or a light load, it will not stop when the field current ceases, but continue to run as an induction motor at a little below synchronous speed; should the motor be heavily loaded, it will probably stop, because its torque as an induction motor is very small.

"OPEN WIRELESS" TELEPHONE SYSTEM.—Recently I heard of a so-called "open wireless" telephone system, but on looking into several books on wireless telegraphy and telephony could find no reference to it. Please describe it briefly.—J. B., Duluth, Minn.

The "open wireless" telephone system is not a wireless system at all in the ordinary sense of the term. It refers to a method of running the wires between a telephone exchange and its subscribers. It should more appropriately be called an all-overhead-cable system, because that describes the manner in which the circuits are distributed from the exchange. Tapering cable is strung along a pole line, usually in the alley. At nearly every pole it is tapped and certain circuits are branched off from the main cable into a small cable that passes up to a distributing box near the top of the pole. Jumper wires lead from this box to a cross-arm, and from this relatively short exposed wire circuits are carried to the subscribers in the adjoining houses. The system is thus "wireless" in having no exposed and complicated mass of wires on the pole lines. It is, therefore, not so unsightly and is freer from disturbance by storms.

SYNCHRONOUS IMPEDANCE; LARGEST TURBO-GENERATORS.—(1) Kindly give me the definition of the term "synchronous impedance." How is it used and where? (2) What is the largest turbo-generator used today?—R. B., Jr., Washington, D. C.

(1) When an alternating-current generator runs at full load it gives a lower terminal voltage than it does at no load, the speed and field current being assumed to remain constant. This drop in voltage is due to the armature resistance and inductance, which the load current encounters at the expense of some copper drop and inductive drop; it is also due to the demagnetizing and distorting effects of armature reaction, which decrease the flux and therefore the voltage generated. The combination of all these effects is termed synchronous impedance; it acts just like an impedance in series in the external circuit. Therefore it can be most readily defined as that value of impedance which, multiplied by the full-load current, will produce the same volts drop as is found between no load and full load on an alternating-current generator. Because it includes the effects of armature reaction the synchronous impedance is not a physical quantity, otherwise it would correspond to the armature impedance. The armature reaction effects vary not only with the amount of load but with its character, decreasing the voltage with lagging (inductive) currents and increasing it with leading (condensive) currents. (2) The largest turbo-generators in use at present have a maximum continuous rating of 14,000 kilowatts. Machines of this capacity were first installed at the Quarry Street Station of the Commonwealth Edison Company, of Chicago, less than two years ago; since that time several other installations of these units have been made in some of the leading central stations in this country. The same company referred to will install within a year at its northwest stations now under construction several turbo-generators having a maximum continuous rating of 20,000 kilowatts. These are now being built and will be the largest prime movers and generators ever realized.

ELECTRIC VEHICLES WITHOUT BATTERIES.—How is it possible to run an electric automobile without storage batteries? A man in this city claims he can do it.—M. R. P., St. Louis, Mo.

An electric vehicle not connected with a power house by means of an overhead or underground trolley or by a so-called surface-contact system can be operated only by means of a self-contained source of electric current. This means that the vehicle must have a set of storage batteries, as nearly all do, or a set of primary batteries, which is impracticable, or a generator driven by some form of engine. The last type of vehicle is not strictly a pure electric vehicle, but a combination, usually of the gasoline and electric types, in which the electric generator, controller and motors take the place of the ordinary mechanical transmission between the engine and the driving wheels. Such an electric transmission is of value for its ease and flexibility of control.

MAGNETITE ARC LAMP.—Who invented the magnetite arc lamp?—B. L., Harrisburg, Pa.

The magnetite arc lamp, also known as the luminous arc or metallic-flame arc, was invented by Dr. Chas. P. Steinmetz, consulting engineer of the General Electric Company.

Reckoning on the basis of the first six months of 1910, the city of Sheffield, England, is exporting to the United States over $4,000,000 worth of steel and steel goods a year, and, notwithstanding the high tariff, the trade is constantly increasing.

New Electrical and Mechanical Apparatus and Appliances.

New Models of Waverley Electrics.

The Waverley Company, of Indianapolis, Ind., announces that its leading Waverley electric vehicle for 1911 is the new Model 81, a four-passenger brougham, resembling in many respects last year's Model 75-C, but with a few important differences. The body of the car is built in a single piece, three inches wider, the front has swelled side panels with rounded front quarter French plate glass, and the general effect of the car is larger, roomier, more luxurious and more distinguished.

The mechanical equipment includes the Waverley high-efficiency shaft drive. The principal feature of this drive is the use of herringbone gears connecting parallel shafts, a device peculiar to the silent Waverley. The controller is based on the principle of knife-blade contacts and has an interlocking device that makes it impossible to change the speed direction with the power on or to start on any speed but the low—thus preventing jerking and jumping when the car starts.

Next to this model in the point of newness, though actually surpassing it in novelty, is Model 78, Waverley electric roadster, a car that was introduced last year, but only in a tentative form. Numerous alterations and improvements are embodied in this year's model. The body, for instance, is low hung. There is a roomy, comfortable rumble seat at the rear, with a step to reach it by. The length of the car has been increased to 114.5 inches and the wheel base to ninety-six inches.

Twenty-five miles an hour is the speed available, and the mileage has been made adjustable to the needs of the owner. If more than a hundred miles on a charge is required, the company is prepared to equip the car with an Edison battery. Minor changes in other types have also been made.

Westinghouse Shipments.

The Westinghouse Electric and Manufacturing Company has broken its record twice in two months. In July the shipments were ten per cent greater than in any month in the company's history. In August the shipments exceeded those of July by $300,000.

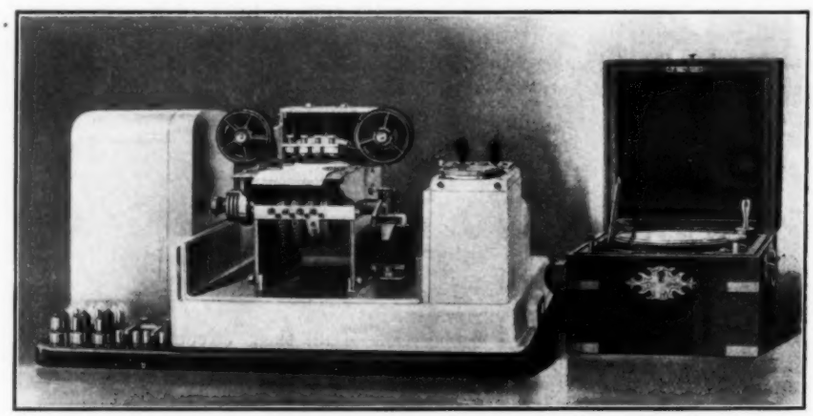
Warner Timing Apparatus.

At the automobile races held recently at Elgin, Ill., under the auspices of the Chicago Motor Club, an electrical device for keeping an accurate record of the time made by each car was used for the first time and attracted a great deal of attention.

The device is known as the Warner electrical timing apparatus and is the invention of Charles Warner, of the Warner Instrument Company, Beloit, Wis. A view of the timer is shown in the accompanying illustration.

The race timer is equipped with four type wheels, operated like an odometer, recording hours, minutes, seconds and hundredths of a second. The record is made on a paper tape through a carbon ribbon by small hammers, actuated by electro-magnets, located over the type wheels. In the circuit of the magnet that operates the hammer is a relay switch operated by another electro-magnet in a circuit that is normally closed.

A light wire stretched across the course a few inches from the ground connects to an ingeniously designed trap that breaks the circuit when a car strikes the wire, releasing the printing hammers and making a record of the exact elapsed time. A small motor which drives the type wheels is electrically controlled and corrected by an accurate chronometer. Any variation in rotation of driving shaft is corrected every second to within one-thousandth of a second. The chronometer is shown alongside of the timer in the illustration.



WARNER ELECTRIC TIMING APPARATUS USED AT THE ELGIN AUTOMOBILE RACES.

A Real Estate Corporation's Private Telephone System.

Private telephone systems have come to be a part of the office equipment of a great many concerns which pride themselves upon being up-to-date. The accompanying illustrations are views of the inter-phone equipment recently installed in the offices of the Queensboro Corporation, a large real estate concern situated on Broadway, in New York City. These instruments, which are automatic in their operation, have been found to be a great aid in the transaction of everyday business by this concern.

Securing an adequate means of intercommunication has often been a serious problem in the laying out of business offices. The fact that various private offices and desks must necessarily be removed some distance from the seat of central authority, even though the occupant of each of these offices has business dealings at all hours of the day with his associates in the same concern, makes necessary the installation of some agency through which these desks, rooms and offices may be welded together into a central organization.

Here is where the private-line telephone comes in, since when such a system is in existence each man finds each of his associates no further away from him than the instrument at the side of his desk.

There are seven stations in the interphone system of the Queensboro Corporation, recently installed by the Western Electric Company. One inter-phone

is at the side of the auditor's desk, another is in the office of the sales manager. Other sets have been placed in the offices of the general manager, the treasurer, the assistant secretary-treasurer, the bond sales manager and the architectural and construction depart-

FIG. 1.—INTER-PHONE IN AUDITOR'S DEPARTMENT.

ment. The system has been arranged so that it may be enlarged at any time by the addition of more instruments.

In all of these rooms but one, hand telephone sets of the one-piece type

FIG. 2.—INSTALLATION IN PRIVATE OFFICE.

have been installed. The general manager uses a desk telephone of the familiar type, with receiver mounted on the hook.

The key-boxes with their rows of buttons and labels furnish the means of intercommunication. Each connecting button has on the label at its side the initials of the man at whose desk the corresponding telephone is placed. A buzzer is placed at each set instead of a bell.

If he wishes to consult two or three of his department heads, the general manager may press the two or three buttons. A conference is started without anyone leaving his desk. Each of the officials of the company has within instant reach the records kept by the bookkeeping department, employing the method shown in the illustration marked Fig. 1.

This system practically eliminates confusion and waste of time. It performs the duties that once were left for messenger boys, speaking tubes, call-bell signals and other awkward and inconvenient methods.

Precision Torsion Balances.

The accompanying illustration is a view of the Hartmann & Braun precision torsion balance, which is a highly developed instrument for weighing light masses with commercial rapidity combined with precision accuracy.

Referring to the illustration, a horizontal staff terminating in conical steel pivots which rest in jeweled bearings is located in the axis of the cylindrical casing, which is carried by the column and tripod support. To this horizontal staff is secured a pointer and a hook-shaped extension, which projects from the case and serves as a support for the object to be weighed. The staff likewise carries a light aluminum disk,

PRECISION TORSION BALANCE.

which swings between the jaws of a powerful permanent magnet, and thus damps oscillations, making the action dead-beat.

Mounted in line with the staff and in front of it is a short shaft, which carries at its inner end beneath the glass cover a pointer, the outer end of which carries a handle, which is clamped to it by means of a thumbscrew. The short shaft is coupled to the jeweled staff first named through a torson spring, which is not under tension when the pointer has been pushed around to the zero of its scale if the hook carries no load.

If a weight is hung on the hook, the staff will be rotated against the torsion spring and the pointer will

sink below zero. By moving the handle with a left-hand rotation the torsion of the spring is increased, and when it exactly balances the torque due to the weight on the hook, the pointer will again point to the zero mark. When this handle is moved to the right as far as it will go, the balance is free, and that fact is visible upon inspection as the arrow carried by the extension of the handle points to "free." Conversely, when it is pushed to the left the balance is locked and the pointer so indicates.

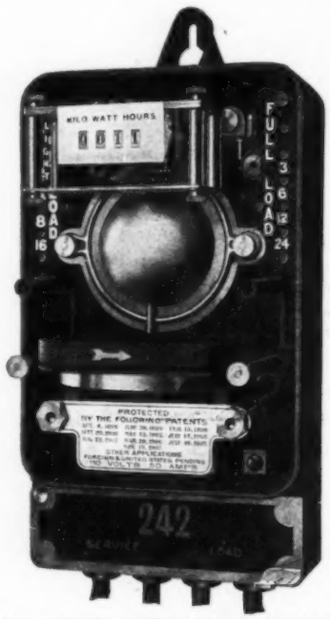
Machado & Roller, 203 Broadway, New York, are the sole United States agents for this instrument.

The Willis Watt-hour Meter.

The watt-hour meters in general use on consumers' premises at the present time are a great improvement over those originally introduced and give a fairly satisfactory service. But there is still room for a considerable improvement in order to promote harmonious relations between the consumer and the central-station company serving him. For the benefit of the former it is desirable to simplify the method of recording the energy consumption, so that anyone can tell at a glance exactly what the reading of the meter is. For the benefit of the company it is desirable to make the meter more secure against tampering or theft of current. For the benefit of both parties it is desirable to increase the accuracy of the instrument at all loads.

With these objects particularly in mind, Prof. G. M. Willis has for a long time been working on the design of a meter which has recently been perfected and put on the market with comprehensive guarantees. In this instrument are embodied the results of his extensive experience in meter manufacture with the largest companies.

As shown by the accompanying views, the Willis meter is a very compact instrument mounted in a glass case, so that it is easy to see its interior without dismantling. Doubtless the most striking feature that is at once noticeable is the method of recording the meter reading. The ordinary meter dials are dispensed with and replaced by the simple direct-reading system used in cyclometers, in counting the rotations of machinery, the strokes of pumps, etc.



WILLIS METER WITH COVER REMOVED.

The reading can always be noted at a glance and there is no possibility of a number sticking part-way. The number changes are positive and do not occur until a full unit of energy has been passed through the meter; thus in the meter shown herewith the reading 11 would not change to 12 until twelve kilowatt-hours had actually been consumed, at which moment the change would take place instantaneously. The reading is also direct because it is given in kilowatt-hours without any multiplying constant. Thus the difficulties of reading the ordinary meter dials accurately are entirely dispensed with.

The Willis meter is of the commutator-motor type, with an unusually light rotating element. Not only is the weight on the main bearing relatively small, but, in order still further to reduce the friction and wear, a ball bearing resting in a cup-shaped sapphire jewel is used. Friction in the registering mechanism is greatly reduced by eliminating worm gears, by very accurate machining of spur gears used, and by plating them with gold to prevent any possible corrosion.

As a result of making the friction practically negligible, the meter is exceptionally accurate throughout all ranges of load. It is guaranteed to vary not more than one per cent above or below absolute accuracy between full load and five per cent of full load. Because the wear in the bearings, the gears and the commutator is insignificant, the meter maintains its accuracy indefinitely, as has been found in repeated tests. However, means are provided for making easy adjustments of

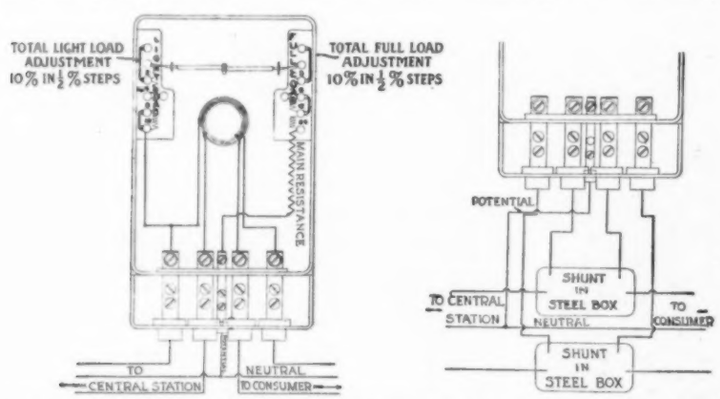
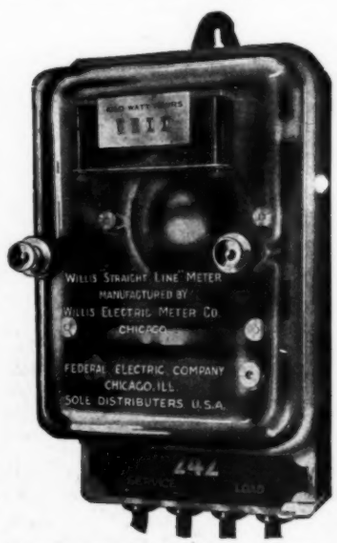


DIAGRAM OF CONNECTIONS FOR ALL THREE-WIRE WILLIS METERS. DIAGRAM ON LEFT FOR CAPACITIES UP TO AND INCLUDING 100 AMPERES. DIAGRAM ON RIGHT 150 TO 800 AMPERES INCLUSIVE.



WILLIS "STRAIGHT LINE" METER.

the resistance and number of turns of the starting coil, for which plugs are conveniently arranged as shown in the accompanying illustrations. This obviates the troublesome adjustment of the damping magnets.

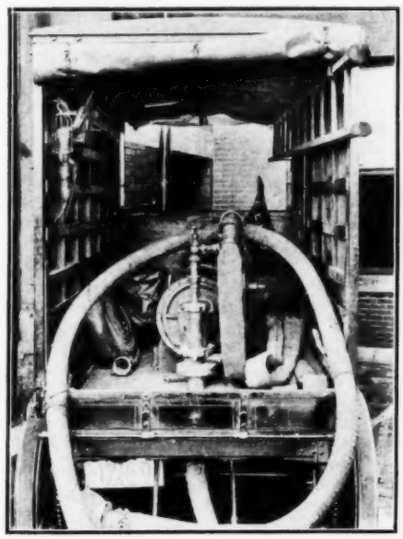
Rubber bushings are molded in place to fit perfectly in each meter between the glass cover and the back of the case. These render the case airtight and moistureproof. Thus no dust, dampness, fumes or other extraneous matter can be introduced into the meter, so that any possible corrosion is still further prevented. This hermetical seal reduces the possibility of tampering with the meter. The screws fastening the meter to the wall terminate within the case, so that no attempts to tilt the meter out of plumb can be made without breaking the seal. Theft of current is further guarded against by placing the terminal box within the meter case.

The meter is adapted for use on direct-current or alternating-current circuits and it can be changed from one to the other without readjustment or calibration. It is also independent of temperature changes.

The Willis meters are made for two-wire or three-wire circuits. In the illustration herewith the connections for three-wire meters are shown. For current capacities over 100 amperes shunts are used in the main line, thus current capacities up to 800 amperes are provided for. The pressure circuits are built for 55, 110, 220 and 550 volts. These meters are manufactured by the Willis Electric Meter Company and the Federal Electric Company, of Chicago, is sole distributor.

Electric Vehicles Displace Manual Labor.

The users of electric vehicles are fast learning that the vehicle and the battery it carries can be made to displace, with a very high percentage of saving, much manual labor necessary in connection with the transportation of their loads. The coal merchant has found that it is far cheaper to dump his load of coal by means of a little motor under the seat of the truck. The safe dealer can, by the use of an electric winch, deliver his heavy goods into any story of a building without the employment of eight or ten men to man a hand winch. The manufacturer of heavy machine tools uses the hoisting winch not only for elevating his load at the delivery point, but also for loading the weighty and bulky articles at the factory or storehouse.

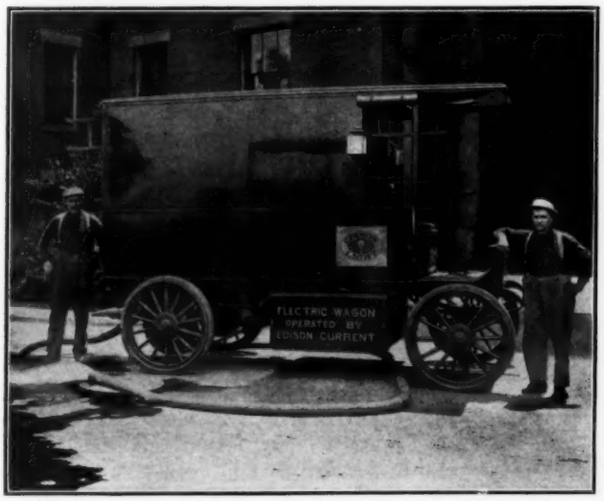


VIEW OF INTERIOR OF VEHICLE.

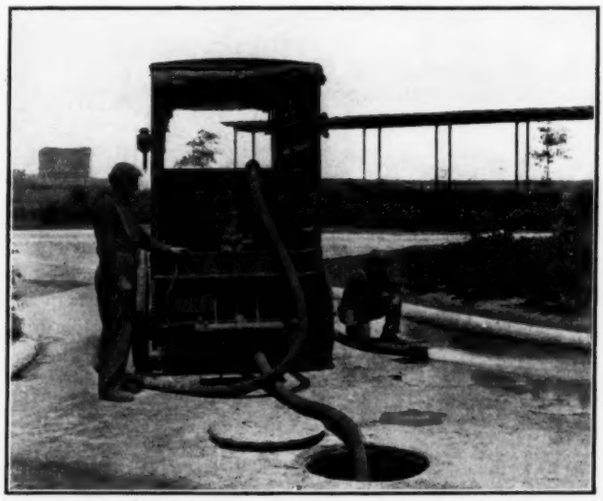
The construction departments of central stations, electric railways and telephone companies find that they can construct lines, set poles, and draw wires and cables with about one-fourth the number of helpers if electric trucks with power winches are used. Many electric light, telephone and telegraph companies are frequently called on to remove water from manholes in the underground service. This was formerly done by teaming a hand pump to the manhole, and with two or four men to man the pump the water was removed in the course of an hour or so. The Boston Edison Company improved on this by placing a gasoline-driven rotary pump on a dray, and later this same apparatus was placed in one of the electric trucks.

It remained for W. C. Woodward, electrical engineer of the Narragansett Electric Light Company, of Providence, to devise the best means for handling manhole pumping. On a solid iron base he mounted an eighty-five-volt motor connected to a rotary pump. A rheostat and wires for connection to the storage batteries of any of their cars were provided. This piece of apparatus can be placed in any of the company's vehicles, and when the manhole is reached the wires are connected to the battery and the water is rapidly pumped out.

The Boston Edison Electric Illuminating Company improved on this method. They ordered of the General Vehicle Company a standard one-ton covered wagon fitted with a 225-ampere-hour battery in place of the 165-ampere-



ELECTRIC VEHICLE AS IT APPEARS ON THE ROAD.



VIEW OF PUMP IN ACTION.

hour one usually supplied. In the body of this vehicle they installed a unit consisting of an eighty-five-volt, twenty-two-ampere General Electric motor direct-connected to a Jager rotary pump. This apparatus running at 1,100 revolutions per minute, consuming twenty-two amperes, will lift 100 gallons per minute from its deepest manhole. The vehicle can travel forty miles, and pump 180,000 gallons of water on a single charge of the battery.

Illustrations are given showing the vehicle as it appears on the road, the interior showing pump and motor, and the pump in action. A double-pole switch is provided so that the pump cannot be thrown in while the vehicle is running, nor the vehicle while the pump is in operation.

The Patterson Wireless Dry-Battery Holder.

In order to eliminate the troubles so common in the battery systems of gasoline motor boats, Stanley & Patterson of New York have designed and placed on the market a wireless dry-battery holder which has many features worthy of note. This battery holder which is the result of a careful analysis of existing troubles entirely does away with loosening connections, bad contacts, etc.

In this device, a Columbia screw-top battery cell without wires or binding posts screws into one solid hard-rubber plate, automatically making all connections. The rubber plate forms a substantial water-proof cover for the battery box. The battery cells are suspended from the plate and do not rest on any surface where dampness can collect.

An especial feature of the Patterson system is the ease with which cells can be renewed. No matter how inexperienced a person may be in electrical matters, he can not fail to connect the cell properly.

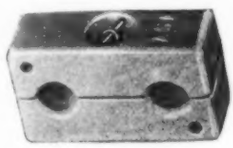
New Passenger-Counting Device.

A new mechanical device for registering the number of passengers as they pass into the New York subway has been installed for trial at the Hoboken station. By cutting a stream of compressed air, which holds an electric circuit open in an instrument across the passageway, each person completes the circuit and is registered.

The "Slipon" Lamp-Cord Adjuster.

The device described and illustrated herewith seems to be a distinct advancement in the manufacture of lamp-cord adjusters. From an inspection of the illustrations it is apparent that the device is readily adapted to the modern methods of installing drop lights, and the manufacturers claim that it will not chafe the lamp cord.

The simplicity, adaptability and handiness of the Slipon lamp-cord adjuster are features which have been,



SLIPON LAMP-CORD ADJUSTER.

in a large measure, responsible for the success with which it has met. It can be installed in a very short time, two seconds, according to the manufacturers, without the use of tools, removal of socket or cutting of the cord.

The Slipon adjuster is constructed of vitrified porcelain, and is finished in white, black and green glaze. It is, of course, fireproof and is not easily broken.

One of the accompanying illustrations show the adjuster when open

ADJUSTER OPEN—READY FOR INSTALLATION.

ready to be applied to the lamp cord. The other illustration shows the device closed, its position when in use.

The Slipon lamp-cord adjuster is being manufactured and placed on the market by the National Electric Specialties Company, 20 Broad Street, New York City.

A New Aluminum Alloy.

A new alloy of aluminum has been discovered by H. B. Weeks, head chemist of Vicker's Sons and Maxim's Works at Barrow, Eng. The alloy, which is called duraluminum, is described as being a little heavier than pure aluminum, and as strong as steel.

Record of Watt-hour Meters That Passed Through a Wreck.

Two carload lots of miscellaneous apparatus *en route* to Denver were recently received there in bad order, having been damaged in a freight wreck on the Colorado & Southern Railway. In one of these cars there were 503 watt-hour meters, and, on account of the jolting they had received, it was deemed advisable to check part of these meters and recalibrate them where necessary. The report of the test on 261 meters proved so remarkable under the conditions that it has been tabulated. The following is a description of the condition of the car containing these meters and of the meters themselves after the wreck:

"The body of the car was almost demolished, the roof having been entirely torn off and the sides broken in. This car went into the ditch, turned completely over, and scattered meters, motors, transformers, etc., along the railway. The majority of the watt-hour meters arrived with the wooden crates missing or badly broken, and there were about fifty of the meters which were entirely out of their individual packing cases, showing that they had received a very severe shaking up. There was one instrument in particular which was received without any packing whatever. The aluminum case was bent all out of shape and the glass window broken. Yet this instrument checked up accurately with the standard."

The following is a record of the tabulations made by the manufacturer:

Precentage of Meters.

Percentage of Error.	Light Load.	Full Load.	Either Light or Full Load.
Within 1% fast or slow.	60%	65%	44%
Over 1%, but within 2% fast or slow	25%	30%	39%
Over 2% fast or slow....	15%	5%	17%
Total	100%	100%	100%

Meters found creeping, 9%.

This record covers 261 meters. Of the rest, one meter was too badly demolished to allow of repairs being made in Denver, and 241 meters were shipped direct to a customer with the understanding that he would check and recalibrate them before putting them into use.

This record shows in a remarkable way that the meters, which were of Westinghouse manufacture, were able to stand the roughest handling ordinarily possible with any form of shipment without impairment of their accuracy.

Current Electrical News

GREAT BRITAIN.

(Special Correspondence.)

LONDON, SEPTEMBER 3.—A curious mishap has occurred at the Brighton electricity works, which are situated on the harbor. The condenser circulating system is supplied from the harbor through a five-foot suction pipe which some ten feet from the water branches off into two thirty-inch pipes. Owing to trouble in maintaining the vacuum a diver was sent down to investigate and has discovered that throughout the whole ten feet length of the five-foot pipe there were clusters of large mussels and other marine growth. The effective bore of the thirty-inch pipes was thus reduced to sixteen inches. Apparently the system has been so laid at Brighton that it is impossible to clean the pipes, and the borough electrical engineer, who is next year's president of the Incorporated Municipal Electrical Association, has been forced to lay down an entirely new system. A new turbine is in course of construction and $4,500 is to be expended putting down a new piping arrangement for this.

The existing turbines are to be dealt with very shortly at an estimated cost of $40,000.

Considerable developments are taking place in connection with the Birmingham Corporation Electric Supply. The limit of expansion of the existing generating station is within sight and the demand is growing at such a rate that preparations are being made for building an additional generating station. In four years the plant capacity has been more than doubled, seven generating sets having been installed during that time and a further one is to be erected next year. Two exhaust steam turbines are also to be laid down increasing the output of existing reciprocating-engine sets from 1,500-kilowatt to 2,500-kilowatt. In spite of opinions to the contrary, the Birmingham Electric Supply Committee is adopting exhaust-steam turbines as a means of utilizing the existing space to the best advantage.

The Japan-British Exhibition authorities have awarded Louis Brennan a grand prize for his gyroscopic monorail railway which has been on view there.

With a view to keeping the public in touch with any important happenings on the chief ocean liners, the Marconi Wireless Telegraph Company is inaugurating a wireless press agency for this purpose. Any items of interest will be dispatched either at the instigation of the captain of the vessel or the wireless operator.

The jubilee of tramways in Great Britain is now being celebrated in Birkenhead, where the late George Train laid his first tramway line, the rails being laid above the surface of the roadway A similar line was constructed in London in 1861. G.

CONTINENTAL EUROPE.

(Special Correspondence.)

PARIS, SEPTEMBER 3.—Among the new companies which have been formed on the Continent one of the most important is Herbert et Cie, of Paris, who will deal in electrical apparatus. At Lyons a new syndicate has appeared which bears the name Lyons Syndicate for Lighting and Power. The Tourouvre Electric Company, at the locality of the same name, and the firm of Bogart and Poisat for electric construction work, are also to be noted, also the Societe Francaise for Light and Power at Douai.

In Holland, the town of Watergraafsmeer is taking measures to increase its electric plant and has contracted a loan for this purpose. In Denmark there is to be run an electric railroad between the localities of Randers and Aarhus. The project calls for a power line which will distribute current to the various towns along the route.

According to recent reports from Japan, it appears that there will be a good opportunity for placing electric material in that country, owing to the action of the government in drawing up a list of the available sources of water power, this with a view of constructing a considerable number of turbine plants in the near future.

The suburban electric railroad running from Vienna to Baden is one of the recent lines in Austria which are now successfully running. It is a standard-gauge line and is about twenty miles in length. Electric traction was substituted for steam on this railroad, although the freight service is still carried out by steam locomotives. The system is made up of two sections lying adjacent to the respective towns and fed at 550 volts direct current from the tramway system. Between these two sections there is a middle one which runs on single-phase current at fifteen cycles. The present line runs parallel to the Southern Railroad, and it now competes with the latter. On the motor cars are mounted four Siemens-Schuckert motors of forty horsepower, which are designed to run on direct or single-phase current, using a trolley wire. Several motor cars go to make up the train. A special controller is used for each of the different systems. A new electric railroad which is now being built in Austria from Vacz to Budapest and Gödöllo presents considerable interest in being the first line in this country to use the single-phase system at 10,000 volts. It is to run between different stations lying on the state railroad line and high-speed trains will be used here. Current will be taken by bow trolley from overhead lines suspended on the Siemens-Schuckert catenary system working at 10,000 volts. Both electric locomotives and motor cars will be used here, these latter being fitted with two 250-horsepower motors.

Sterilization of water by ultra-violet rays is now carried out on a practical scale by the small apparatus which has been brought out at Paris. It is designed after the method of Courmont and Nogier, using a quartz mercury-vapor lamp placed in a cylinder so that the water flows by it in a continuous stream. The new apparatus is designed for domestic use and is fitted to the water piping. An electromagnetic valve stops the water in case the current should fail, so that the water is always sure to be sterilized.

Among recent electric projects in Russia I note an electric railroad which will be built from Sebastopol to Yalta. The city of Odessa is taking measures to install an electric tramway system. The electric lighting has been conceded to a Belgian syndicate. Owing to the extensive work which is to be carried out in transforming the port of Odessa, there will no doubt be ordered a considerable amount of electric material. At St. Petersburg the government proposes to construct a special electric-traction line which will connect all the railroad stations in the city and will cost upwards of $16,000,000. It may be some time, however, before this idea is carried out. A project is on foot for using eletric traction on the railroad lines lying within the city and in the suburbs, and the railroad department is now engaged in drawing up the preliminary plans. The expense is figured at $20,000,000. An important work will be the electric railroad which it is proposed to build in order to make connection between the Finland railroads and the Imperial railway system.

Electric traction matters are also active in Italy. The state railroad department proposes to use electric locomotives upon no less than 500 miles of railroad line. In order to supply the current, it is planned to build an electric station which will work upon a 40,000-volt power line. A. DE C.

EASTERN CANADA.

(Special Correspondence.)

OTTAWA, ONT., SEPTEMBER 10.—The transmission line of the Ontario Hydro-Electric Commission from Niagara Falls to Berlin has been submitted to an extraordinarily rigid test for a few days recently. A voltage of 180,000, or 70,000 volts more than the line was designed to convey, was successfully carried by the wires over a distance of 115 miles.

E. B. Backus, president of the Minneapolis & Ontario Power Company, and Mayor Williams, of Fort Francis, Ont., have arranged with the Hydro-Electric Commission for a report from engineers as to what price the company should charge Fort Francis for power. This has been a troublesome question for some time between the town and the power company.

As soon as there is some definite announcement as to the date when hydroelectric power will be delivered in Toronto and distributed by the city's plant, the civic electrical department will issue its schedule of rates. These have been compiled for some time past, but have not been published, lest they be of service to the Toronto Electric Light Company.

The special civic committee of the Toronto City Council appointed to deal with the traction systems, has decided to recommend the Council to buy out the Toronto Street Railway Company. Messrs. Jacobs and Davies, the tube experts, recommend this course, in view of the difficulty of operating a tube system in competition with surface lines, and the profit with which both systems could be run under civic ownership and control.

David Fasken, president of the Cobalt Hydraulic Power Company, has bought out the interest in the Cobalt Power Company, Ltd., formerly held by R. Beach. This gives Mr. Fasken a controlling interest in the latter company, which is now developing about 3,000 horsepower at Hound Chutes, on the Montreal River, about six miles from Cobalt. This power is sent to the mining camp at 11,000 volts. Eight out of the thirteen mills in Cobalt are being run with power from this company.

The Dominion Commission on Conservation, here, has received notice that the city of Winnipeg, Man., has filed a protest with the International Waterways Commission regarding the alleged cutting off of over four per cent of the city's water power through license issued to the Minnesota Power and Canal Company. The city claims that the license granted by the United States secretary of war,

gives the company power to divert the waters of Birch Lake to the St. Lawrence River, which is affecting the civic power plant to no little extent.

The mayor of Fort Francis, Ont., recently presented a petition to Sir Wilfrid Laurier, asking that the federal license, by which the Ontario & Minnesota Power Company develops electric power and exports half of it to the United States, be not renewed, claiming that the contract had not been lived up to, and asking that the rates be fixed by the government. Sir Wilfrid in reply said: "The Rainy River is a most valuable water power. It has been flowing for thousands, perhaps millions, of years, perfectly useless to man. No Canadian capital came forward to develop it, but six or seven years ago American capital came over and as the stream was international, it was necessary to get the approval of Ontario and Minnesota. This was given on conditions which have been needlessly complicated by subsequent obligations, both at Toronto and Ottawa. I have endeavored to look at the problem from the point of view of common sense, and I have come to the conclusion that it was in the interests of Fort Francis and of the company that it should be used equally on each side of the river for the benefit of the people of Ontario and Minnesota." W.

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

Seventy-five representatives of gas and illuminating companies doing business in New York State, were present recently at the order of the Public Service Commission, Second District, to discuss the proposition of rate schedules and the form of report blanks relative thereto.

There are 192 gas and 348 electrical corporations doing business in this state and to all of them notice of the proposed discussion had been sent. Chairman Stevens called attention to the fact that the Commission had no power to establish rates in the first instance, but its jurisdiction was confined to the revision of rates which had been found unreasonable or discriminatory, after hearings upon complaints filed with the Commission. He said that an examination of the field schedules disclosed the fact that there was no scientific system of rate-making and the charges in the majority of cases were the result of haphazard guessing by the company.

R. M. Searle, vice-president of the Rochester Railway and Light Company, informed the commission that at meetings of the Empire Gas and Electric Association there had been frequent discussions as to the advisability of securing a uniform system of rate-making. He expressed pleasure at the privilege of being afforded an opportunity of filing its rates. In concluding he advocated small committees to consider the question.

It was the opinion of J. C. De Long, vice-president and general manager of the Syracuse Lighting Company, that a committee of the State Association, representing both large and small companies and a member of the Public Service Commission should constitute a committee as suggested by Mr. Searle.

The following committee was then appointed: J. C. DeLong, J. P. Hutchings, general manager of the Rochester Railway and Light Company; J. T. Cowling, engineer of the Westchester Lighting Company; F. B. H. Payne, general manager of the Lockport and Ontario Power Company; A. C. Smith, sales engineer of the Cataract Power and Conduit Company, Niagara Falls; T. R. Beale, of the Poughkeepsie Light, Heat and Power Company, and M. W. Offutt, general manager of the Schenectady Illuminating Company. It is within the power of this committee to add to its members if it so desires.

Chairman Stevens of the Public Service Commission, held that it would not be judicious for one of the members of the Commission to act upon this committee, but said he believed that the Commission should be wholly free to pass upon the work of the committee without any suggestion that it had taken part in it. He stated that the Commission would select as its representatives upon such committee, Messrs. Crowell, Hunter and Griggs of its staff.

Chairman Stevens queried the members present as to the interpretation of the law, and held that the charging for electric current by flat rates was entirely in violation of the effective statute prohibiting discriminatory charges.

Morris B. Cohen, Jr., of the Buffalo and Niagara Falls Electric Light and Power Company, and Cliff Electrical Distributing Company, said that his company would not like to have any form of schedule adopted which would exclude the flat rate, inasmuch as it held a number of contracts on this basis which had many years to run, several of them being effective for seventy years. He said that he believed in the preparation of a form of schedule of rates, but that it should not include any contracts heretofore made and that any sales of power in exess of 100 horsepower should not be required to be filed; if the latter contracts were required to be filed, the privilege of change upon less than thirty days' notice should be allowed.

In speaking for the Niagara, Lockport and Ontario Power Company, Attorney Fred B. Corey said that in order for that concern to "maintain its equilibrium," it was necessary, in fact absolutely essential, that it be allowed to sell its power on the flat-rate basis.

Among the others who spoke at the conference were the following: L. T. Palmer, of the Interurban Gas Company of Geneva; M. W. Offutt, F. B. H. Paine, E. H. Wood, owner of the Elizabethtown Electric Light Company; L. W. Emerick, vice-president of the Fulton Light, Heat and Power Company; E. H. Lather, of the Nassau Light and Power Company and W. R. Addicks, of the Westchester Lighting Company.

COMMISSION NEWS FROM WISCONSIN.

(Special Correspondence.)

The Sheboygan Railway and Electric Company has been authorized to issue bonds to the amount of $600,000. These bonds are described as "refunding and improvement five-per-cent gold coupon bonds of denominations of $1,000 and $500 each, said bonds to be issued under a mortgage or trust deed held by the Wisconsin Trust Company of Milwaukee. Four hundred and forty thousand dollars of said bonds shall be used for retiring or refunding an outstanding bond issue to the amount of $400,000; $160,000 for the purpose of paying outstanding floating indebtedness. The balance of the fund is to be used for erecting new car barns, additional rolling stock, machinery, etc. Said bonds are to be sold for not less than seventy-five per cent of their par value.

On September 1 The Milwaukee Electric Railway and Light Company put into effect a new schedule of rates for electric service for commercial, residence and display lighting and for power in the city of Milwaukee. This revised schedule was very carefully devised by the above company, and was filed with the Commission and approved by it. The schedule is, in part, as follows:

To the consumers signing the company's standard form of contract providing for service for one year or more, the charge for electric service shall be computed on the following basis:

DEMAND CHARGE.

$42.00 per year for each kilowatt of demand of the first ten.
$30.00 per year for each kilowatt of demand of the next fifty.
$24.00 per year for each kilowatt of demand in excess of sixty.

The above plus an energy charge as follows:

ENERGY CHARGE.

Five cents per kilowatt-hour for the first 100 kilowatt-hours consumption during month.

Four cents per kilowatt-hour for the next 900 kilowatt-hours consumption during month.

Three cents per kilowatt-hour for the next 3,000 kilowatt-hours consumption during month.

Two cents per kilowatt-hour for the next 6,000 kilowatt-hours consumption during month.

1.5 cents per kilowatt-hour for all energy consumed in any month in excess of 10,000 kilowatt-hours.

(a) Lighting Service.

The foregoing rate shall apply to all consumers utilizing company's electric service for lighting and receiving free renewals of company's standard lamps.

(b) Power Service.

The foregoing rate, less one-half cent per kilowatt-hour, shall apply to (1) all consumers utilizing company's service for the operation of electric motors and not receiving any free renewals of company's standard lamps and to (2) all consumers utilizing company's service for any purpose and not receiving any free renewals of company's standard lamps.

LIMITED OR "OFF PEAK" SERVICE.

The foregoing rates for electric lighting and power service respectively, less one-half the "demand charge," shall apply to all consumers contracting to utilize and utilizing the company's service at times during the calendar day, other than from 6 p. m. (graded to 4:30 p. m. in December) to 7 a. m.

"TEN-SEVEN" SERVICE.

The foregoing rates for lighting and power service respectively, less three-quarters of the "demand charge" shall apply to all consumers contracting to utilize and utilizing the company's service only during the hours 10 p. m. to the following 7 a. m.

MAXIMUM RATE OF CHARGE.

The company states that the maximum rate of charge for service during any one month shall not be greater than the rates for service that would be obtained under the existing increment rate schedules, with the prompt payment discounts applying thereto. Present lighting rates vary from three cents to twelve cents per kilowatt-hour. Power rates vary from three cents to eight cents per kilowatt-hour.

Special flat rates are offered under yearly contracts.

For midnight service the range of rates is from $3.80 to $110.40.

DISCOUNT FOR PROMPT PAYMENT.

On bills paid at the offices of the company within ten days of date of bill, a discount of five per cent of the first twenty-five dollars of all bills and one per cent on amount in excess of twenty-five dollars will be given. These discounts do not apply where a special discount is given in the schedule.

SHORT TIME RATES.

To consumers obtaining service for periods of less than one year the charge for electric service shall be computed according to the existing increment rate schedule with the prompt payment discount of five per cent applying thereto.

LIGHTING AND POWER.

(Special Correspondence.)

FAIRMONT, MINN.—Bonds for the improvement and enlargement of the electric light plant have been voted. C.

ZORTMAN, MONT.—The power house and electric lighting plant of the Ruby Gulch Mining Company was recently burned. C.

REDWOOD FALLS, MINN.—A forty-horsepower water motor and gasoline engine are being installed at the electric light plant.

PRESCOTT, ARIZ.—The Arizona Power Company is to spend $100,000 in building a forty-mile wire from here to Verde valley by way of Jerome. A.

CROSBY, MINN.—A light franchise has been granted to H. F. Pierce, of Bay City, Mich., and construction of the plant will be started at once. C.

SPRINGFIELD, ORE.—District Manager Spencer announces that H. M. Byllesby & Company will double the capacity of the power plant here this year. A.

DARDANELLE, ARK.—A twenty-four hour lighting service has been inaugurated here as a result of an agreement with the Russellville Water and Light Company.

WINFIELD, KANS.—The city has taken charge of the power plant formerly owned by private interests, and has made arrangements for putting it into operation at once.

LOGAN, IOWA.—An offer of $6,000 has been made by the Bullock Public Service Company for the local electric light plant. Stock will be issued for about one-half of the bonds given.

EVANSVILLE, IND.—Charles F. Smith, president of the new Public Service Company says the electric lighting and heating system in this city will be completed and in operation by Nov. 1. S.

BRAZIL, IND.—The city council has voted to make a test of the efficiency of the tungsten lights for illuminating purposes in this city. These lights will ultimately take the place of all the old style overhead lights in this city.

PARKER CITY, IND.—The city council is planning to establish a municipal lighting plant. There is a difference of opinion whether the light should be electricity or acetylene. The commercial club has been called upon to decide the matter. S.

MUSKEGON, MICH.—The proposed issue for $75,000 for the municipal light plant is being slowly taken up. H. W. Noble & Company offered to take the issue at par, but demand a premium of $50, and ask $2,500 for legal expenses.

MIDDLETOWN, CONN.—Work is progressing rapidly on the new plant of the Middletown Electric Light Company, and considerable machinery has already been installed. Current will be supplied to local consumers in about two months.

WALLACE, IDAHO.—As a result of the forest fires which burned in the St. Joe and Coeur d'Alene districts August 21 and 22 the line of the Washington Water Power Company east of Wallace, was damaged and power was cut off from the mines.

SPOKANE, WASH.—A hydroelectric plant owned by Portland, Spokane and Nelson people is being installed near the property of the International Lead Company on the East Pend d' Orielle River. The plant will have a capacity of about 65,000 horsepower.

BANNING, CAL.—The Consolidaed Reservoir and Power Company is progressing rapidly with its work to divert the water of the Whitewater River to the land owned by this company north of this city. Two or three electric power houses will be built along the diverted stream. A.

PONTIAC, MICH.—The new power house of the Rapid Motor Vehicle Company has been put in service and will hereafter furnish all the heat, light and power for the Rapid plant as well as light and power for the Cartercar factory. The new plant will furnish 1,600 horsepower.

FREMONT, NEB.—By purchasing a new 500-kilowatt steam turbine the city will more than double the capacity of the municipal light plant. The board of public works has been instructed to advertise for bids for the new engine, which it is expected will cost between $12,000 and $14,000.

WACO, TEX.—The civic improvement committee of the Business Men's Club has stated that it is ready to receive offers as to ornamental lighting of some of the main business thoroughfares. The matter will be put through at once, if possible, according to C. W. Coons, secretary of the Business Men's Club.

CADILLAC, MICH.—Fire recently damaged the Cadillac Water and Light Company's plant about $10,000 and put industries using its current out of commission until temporary repairs were made. Two fuel and storage houses were destroyed, but the main part of the power plant was not reached by the flames.

HILLSBORO, ILL.—Fifty thousand dollars will be spent this fall by the Hillsboro Electric Light and Power Company in enlarging the local plant. The company intends to furnish light and power not only in every city and village of Montgomery County and to the mines, but in the country districts as well.

ATLANTA, GA.—Plans for the ornamental lighting system for Whitehall, Peachtree and Mitchell streets will doubtless be carried out as they stand. As yet the only hindrance has been the failure of a few property owners and tenants to sign the agreement under which the system is to be installed.

PETERSBURG, IND.—The Wabash River Power Company, which is completing the utilization of the water power afforded by the Government locks near Mt. Carmel, has sold its assets to the Wabash River Syndicate, J. J. Henry, of New York City, and J. B. Blackburn, of Grayville, Ill., being the purchasers.

CONCORD, N. C.—Work is progressing on transmission lines from this point to the Bala cotton mills, on Coddle Creek, the mills having contracted to use the electric drive rather than steam, procuring power from the Southern Power Company, Charlotte, N. C. The line will be completed about September 15. L.

ELDERON, WIS.—Articles of incorporation have been filed incorporating the Elderon Light and Power Company, organized recently by A. J. Plowman, A. M. Olsen and L. G. Jacobson. The business of the corporation will be to manufacture and sell electric light, signals, heat and power. The company has a capital stock of $4,000.

IDAHO FALLS, UTAH.—There has been a reorganization of the Idaho Falls Power and Transportation Company. J. W. Springer of Denver has taken entire charge of the work. Seven cars of new machinery has arrived, which will soon be installed. A large amount of Denver capital is said to have recently been invested in the company.

OTTAWA, ONT.—The Canada Gazette has incorporated the Montreal Hydro-Electric Company, Limited. The capital is $10,000,000 divided into 100,000 shares of $100 each. The headquarters are in Montreal. The incorporators are all Montreal residents and are given "right to carry on all matters pertaining to electric light, heat and power development."

OVID, N. Y.—The electric company will have practically a new plant at Tanghannock, with three sources of power, water, steam and oil. The steam plant will consist of two 125-horsepower boilers and a Westinghouse engine, the oil power will come from a Deisel engine of 100 horsepower, while the water power will remain as at present with some alterations and improvements.

BATESVILLE, IND.—The Batesville Electric Light and Power Company, is the name of a company organized and incorporated for the purpose of building and installing a plant to supply the city of Batesville and other cities and towns with water, heat, light, and power. The initial capital stock is $10,000. John A. Hillenbrand, A. W. Romweber and Harry Blank are directors. S.

PHELPS, N. Y.—This city has been in darkness owing to a difficulty between the lighting company and the water commissioners. The water board by diverting the water from the main supplying the section in the lighting company's locality effected a shut-down at the electric light plant, it being quite impossible to obtain sufficient water for the boilers from any other source.

SAN FRANCISCO, CAL.—The first unit of 5,000-horsepower of the San Joaquin Power Company's Crane Valley Power Plant in Crane Valley was turned on recently. Work preliminary to starting the second unit will commence in a short time and Mr. Wishon, manager of the power company, expects the two units necessary to complete the plant to be in operation by the spring of next year.

MICHIGAN CITY, IND.—The Michigan City Gas and Electric Company is contracting to supply power to outside towns and has just contracted to furnish the Sal Mountain Asbestos Company, of Chesterton, with 350 horsepower for a term of years at the rate of $1,800 per month. The company will order twenty-three motors, ranging in size from fifty horsepower down to one-quarter horsepower. S.

GRAVETTE, ARK.—The city of Gravette has bought the electric light plant from the Electrical Promoting Company and will increase and improve the service. A larger dynamo has been purchased and steps already taken for improving the entire system, which was installed in the spring by the above company. E. F. Craven, owner of the Peacock Roller Mills, has been engaged as superintendent.

BELAIR, MD.—The Belair Electric Company has filed with the Public Utilities Commission application for a $25,000 bond and $12,500 preferred stock issue. The proceeds will be used to extend its lines and the betterment of the company's two plants. The company, of which J. Alexis Shriver is general manager, supplies electricity for lighting and power purposes in Belair and as far as Fork, in Baltimore County.

ROCHESTER, N. Y.—The Rochester Railway and Light Company will supply electric current for power at the Brighton pumping station for $53.00 a horsepower per year. It is estimated that fifty horsepower will be needed. The company has supplied the plant with power for a year and a half at the rate of two cents a kilowatt hour. The total cost was $2,148.38. The station was being operated experimentally during this time.

RIVERHEAD, L. I.—The Riverhead Electric Light Company is modernizing the electrical equipment in its power station, and before the transformation is completed all of the old equipment will be replaced by a new system. The voltage is to be increased from 1,100 to 2,300 and the frequency will be changed from 125 to sixty cycles. New generators, switchboards, etc., have been received at the power station and are now being set up. The company

has a franchise to light Westhampton Beach and work on the line across the plains is now being rushed.

BALTIMORE, MD.—The United Railways and Electric Company is still negotiating with the Pennsylvania Power and Water Company for power which the latter company will transmit to Baltimore from the Susquehanna River, and it is more than likely that the contract will be closed within the near future. The Consolidated Gas, Electric Light and Power Company has already closed a deal with the Pennsylvania company for electric power from McCall's Ferry.

GREENVILLE, S. C.—The Home Light and Power Company has been chartered at this point by local capitalists and W. S. Lee, of the Southern Power Company, which company will supply power to the newly organized concern. The Home Light and Power Company, of which J. Thomas Arnold is president and treasurer, is chartered to do a general lighting and power business in Greenville. The capital stock of the company is placed at $100,000. L.

CLEVELAND, O.—It is announced that the city will, some time this winter, begin the work of placing all wires underground. This change will be made when the city plant begins the lighting of the new territory recently added to the city. The street lighting of this territory is to be done by 400 magnetite lamps, which will be installed at a cost of between $50,000 and $75,000. Two new substations, a new switchboard, new poles and wire will be required.

SAGINAW, MICH.—By a deed, which was executed June 23, 1910, the Bartlett Illuminating Company, of this city, has transferred its physical properties and real estate to the Saginaw Power Company. The consideration was not definitely named, the new concern taking over all the outstanding obligations with the exception of a $60,000 floating indebtedness. The deed was executed by M. D. Dalbridge, of New York, as president, and H. S. Brown, assistant secretary.

EVANSVILLE, IND.—The Wabash River Power Syndicate, headed by J. B. Blackman, of Harrisburg, Ill., has taken over the assets and property of the Wabash River Power Company, including a dam 1,185 feet in length with a fall of eleven and a half feet at Grand Rapids in the Wabash River. The new owners propose to dredge the river and make the fall at least seventeen and a half feet. The improvement will cost $500,000. A hydroelectric power plant will be developed at this point. The principal offices of the syndicate will be located in Chicago and Evansville. S.

CANANDAIGUA, N. Y.—The Ontario Light and Traction Company, of Canandaigua, a corporation controlled by the Rochester Railway and Light Company, is carrying out an extensive system of improvements to the Littleville plant, which is located on the outlet of Canandaigua Lake. The present output of the Canandaigua plant is nearly three hundred horsepower, most of which is carried to Rochester over a high-tension line, where it is connected with the city distributing stations. By means of the projected improvements, practically all of the water resources of Canandaigua Lake will be conserved.

ASHEVILLE, N. C.—The Tri-County Public Service Company, chartered recently, has organized with R. S. Howland, president; William Farr, vice-president and general manager; Chas. G. Lee, secretary and treasurer. The above named also constitute the directorate of the company. This concern proposes to furnish electric power and telephone service to the territory about Asheville. It is stated that while the details of the operation of the new concern have not been made public, that it will furnish power in rural communities, and also operate rural telephone exchanges. Mr. Howland has long been identified with the electrical interests at Asheville. L.

NASHVILLE, TENN.—Most of Nashville's underground wiring has been completed. All trunk lines are underground and only a small portion of the original amount of light wiring yet remains to be laid. While the city of Nashville has the smallest amount to do, its expense alone will amount to over $100,000. The Nashville Railway and Light Company will expend about $850,000, while the Cumberland Telephone and Telegraph Company's work will amount to at least $400,000. The contract for the fire-signal cables was let by the Board of Public Works to the Standard Underground Cable Company. It is expected that all wires in the city will be underground not later than June 1, 1911.

KELVIN, ARIZ.—The Ray Consolidated Copper Company has purchased from the General Electric Company complete switchboard apparatus for the generating station, mill substation and mine substation. There will be fourteen panels in the generator station to control four 2,200-kilowatt-ampere 6,600-volt generators with five feeders—one for the station auxiliary, two for the mill substation, one for the pump station and one for the transformers to step up to 44,000 volts, for the mine substation, twenty miles away. In each of the substations there will be a ten-panel board to control transformers stepping down from 6,600 to 460 volts in the mill station and from 44,000 to 460 volts in the mine substation. The boards in each station are to control feeder circuits for induction motors. K-12 and K-6 hand-operated oil switches will be used on 6,600 and 44,000-volt circuits and K-2 switches will be used on 460-volt circuits.

ELECTRIC RAILWAYS.

(Special Correspondence.)

SALT LAKE CITY, UTAH.—A Evans, and others, have been granted a fifty-year franchise for an electric suburban railroad through Utah County.

ARGENTA, ILL.—A committee, of which Attorney C. A. Denison of Argenta is chairman, is seeking to have the line of the Illinois Central Railroad between Champaign and Monticello electrified. Z.

RIVERSIDE, CAL.—H. E. Huntington intends to make this town the division headquarters for his Southern California interurban system. A 100-foot strip of land for this purpose has already been bought. A.

SOUTH BEND, ORE.—J. D. Carey, a Philadelphia capitalist, has applied for a franchise to operate an electric road between this place and Raymond, Ore. Construction work will begin as soon as the franchise is granted.

RUTLAND, VT.—Work on the Rutland Railway Light and Power Company's trolley extension to Poultney is in progress under the direction of George Reynolds, of Fair Haven. The rails will not be laid until next spring.

GRAFTON, W. VA.—The yards of the Baltimore and Ohio Railroad are to be lighted from Col. John T. McGraus' new power plant. The plant will also furnish light for customers in the city and will supply power for the trolley line of the Grafton Traction Company.

SAN DIEGO, CAL.—The San Diego Electric Railway Company has had plans drawn for a new power station, costing about $225,000, which is to occupy the entire block from D to E streets and from Arctic to California streets. The company also plans to erect a $40,000 machine shop. A.

GRANDVIEW, ILL.—A four-mile right of way through Grandview Township has been offered the Central Illinois Public Service Company if it will build its proposed interurban railway through Grandview instead of two miles north of the village as planned. Z.

POTTSVILLE, PA.—The Midland Railroad Company, which will construct a new trolley line in the west end of Schuylkill County, terminating at Ashland, has placed a $2,000,000 mortgage on file at the court house. The mortgage is in favor of the Title Insurance and Trust Company, of Philadelphia, and is in the shape of a trust bond.

ELMIRA, N. Y.—The town board has granted to the Elmira Water, Light and Railroad Company a franchise to construct an electric trolley line on Pennsylvania Avenue from the city limits south to Caton Avenue, at Southport Corners. It is now only necessary to secure a franchise for that part of the line which runs on the city streets.

SAPULPA, OKLA.—The Sapulpa & Interurban is laying rails for its new lines on South Main Street, and it is expected the line will be opened for traffic within a short time. The interurban cars from Kiefer will be operated over this line instead of the present route through the southwest part of the city. The line is now operated into the village of Kiefer.

CHAMPAIGN, ILL.—The board of directors of the Kankakee-Urbana Traction Company has elected officers for the ensuing year as follows: President, W. J. Brock, Kankakee; treasurer, J. Henning of Chebanse; secretary, William Hickley, of Kankakee. The company is still at work on its proposed line between Kankakee and Urbana, to be known as the "University Route." S.

BIRMINGHAM, ALA.—Within the next few weeks the new car line running from Birmingham to Shades Creek via Edgewood will be in full operation. Already all the ground work has been done, and the Birmingham Railway, Light and Power Company is working on the overhead construction now. The northern terminus of the line has not yet been decided on.

WHEELING, W. VA.—The Buckhannon, Weston & Glenville Electric Railway Company, Buckhannon, has been incorporated to build a railway from Sago, Upshur County, to Buckhannon, through Weston and Glenville. The authorized capital is $5,000. Incorporators: S. C. Rusmisell, L. H. Morrison, J. G. Hall, L. H. Treppett, W. H. Gaston, G. F. Day, C. E. White, D. O. B. Hall, of Buckhannon, and J. A. Crislip, Clarksburg.

PEN-MAR, MD.—Crum & Davison, engineers, of York, Pa., have started with a corps of men to survey the route of the proposed extension of the Chambersburg, Greencastle and Waynesboro Electric Railroad from Pen-Mar to Blue Ridge Summit, a distance of several miles. Right of way, it is said, has already been secured. It is probable work on the extension will be commenced shortly. It will be rapidly pushed.

ONEIDA, N. Y.—It is reported here that the last consent for the right of way for the proposed electric road between this city and Rome had been secured, and D. C. Hadcock, who has been promoting the line, states that everything is now in readiness for the formation of the company to construct the line. It is understood that there is a number of persons along the line of the proposed road who are willing to invest in it.

SPRINGFIELD, ILL.—A certificate of incorporation has been filed by the St. Clair Traction Company, with its principal offices located at Belleville, Ill. The capital stock of the company is $2,500. The object is to construct an interurban railroad from the city of Belleville to a point in St. Clair County. Incorporators and first board of directors are Edward L. Thomas, David O. Thomas, C. A. Heinzelman, D. D. Turner, Jr., and William A. Twenoefel, all of Belleville, Ill. Z.

ADA, OKLA.—Lewis Lampke has under construction the first line of a proposed system of interurban railway in Central Oklahoma from Stillwater to Jennings, in Pawnee County, a distance of fifty miles. A charter for the Company under the name of the Oklahoma Public Service and Interurban Railway, was granted recently with $100,000 capital stock, the estimated cost of the proposed system being $6,000,000. The lines proposed under the charter connect a number of Oklahoma towns.

EASTON, PA.—At a recent meeting of the stockholders of the Northampton Traction Company, a majority voted in favor of the proposed merging of that corporation with the Easton and Washington Trolley Line and to increase the bonded indebtedness from $750,000 to $5,000,000, the money to be used in paying off the floating indebtedness of the two companies and to build the extensions planned. A part of the improvements planned is the building of a bridge over the Delaware River at this place to connect the two roads.

PALTO ALTO, CAL.—A large force of men are now employed on completing the roadbed for the extension of the Peninsular Electric Railroad Company's lines through to Dumbarton bridge. The work will be completed at once. This will make a circle of the city by the company's lines. Continuous connections with the other lines of the electric company can now be had, with all points in the county through to San Jose. It is understood that work will be started soon on the line from here to San Mateo. With its completion a through service can be had from San Francisco to San Jose and points further south.

STOCKTON, CAL.—The Sierra & San Francisco Power Company, the holding corporation for the United Railroads of San Francisco, is planning to supply the southern section of San Joaquin County with electric power. The company has ordered from the east, two transformers which will be installed at Manteca or Escalon to reduce the voltage from 100,000 to 15,000. The Sierra & San Francisco Power Company is now building a second transmission line from the head waters in Tuolumne County to San Francisco and planning to equip the system so that a break in either line will not interfere with the supply of electricity at any point. A.

LOGAN, UTAH.—Applications for an interurban road in the Cache Valley have been made by Leo Nielsen and David Eccles, of this city. Mr. Nielsen's scheme is to connect Logan and other towns with a summer resort at the mouth of Blacksmith Fork Canyon. According to the plat filed with the commissioners the road will be about fifty miles long, its northern terminus being at Preston, Idaho, in the north end of the valley. The company is willing to begin construction work in ten months or a year, and are willing to finish it in five years, agreeing to build ten miles the first year. The company is incorporated for $100,000, and bonds will be issued for $700,000. The company has purchased land at the mouth of Blacksmith Fork Canyon, and will spend $50,000 in building a big resort there.

DECATUR, ILL.—Stockholders of the Decatur & Southern Traction Company have voted to increase the capital stock of the corporation from $25,000 to $1,500,000, and a bond issue of $1,500,000 was authorized. The road has entered into a contract, according to President Peter Chase, whereby it will have use of the freight and passenger facilities of the Illinois Traction System both at Decatur and St. Louis. Survey of the route through Pana, Nokomis, Witt, Irving, Coffeen, Greenville and Venice will be made at once. It is estimated two years will be required for the construction of the 128 miles of track connecting St. Louis and Decatur. The average cost per mile will be $35,000. Just south of Decatur where the Sangamon River flats are to be crossed and considerable structural steel will be needed, the cost will reach $55,000. Locations for power houses have not been selected, but probably will be at Decatur or Nokomis and Venice. Z.

LEAGUE CITY, TEX.—Work is soon to begin on the main power plant of the Galveston-Houston Interurban Line, which will be located at this place. The building is to be of steel frame with brick and concrete foundations and walls, two stories high, and 70 feet wide by 100 feet long. The equipment will consist of three 520-horsepower Babcock & Wilcox boilers, with an aggregate of 1,500 horsepower; two steam-turbine generating sets, one of 1,110-kilowatt capacity and one of 500-kilowatt capacity, and other machinery, such as feed pumps and water heaters. The power will be generated at the main plant at a voltage of 2,300, but will be stepped up to 3,300 for transmission to the substations. One of the three substations will be situated about eight miles south of Houston, another near Dickinson and the third between Texas City and Virginia Point. It is stated that they will be of the same type of construction as the main plant, of steel frame with brick walls.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

HILLYARD, WASH.—The Continental Wireless Telegraph and Telephone Company has been granted a permit for the construction of a wireless station here.

EXCELSIOR SPRINGS, MO.—The new central-energy switchboard is being installed and will be in operation in a short time. About $50,000 has been spent for telephone improvements in Excelsior Springs during the past year.

GALLIPOLIS, O.—A plan is under consideration to do away with the telephone exchanges at Malaby, Bulaville and Eno and centralize those lines at Bidwell. Arrangements will be made to improve the line connecting Bidwell with Gillipolis at an early date.

TACOMA, WASH.—It has been decided that all electric wires are to be laid underground here. The Home Telephone Company, the Western Union Telegraph Company, the Bell Telephone Company and the Postal Telegraph Company have commenced work on their wires.

SPRINGFIELD, TENN.—The Springfield Home Telephone Company was sold under decree of the chancery court by A. L. Dorsey, receiver. A. H. Cady of Ohio, representing the bondholders, was the purchaser at $9,250. There are exchanges of the Springfield Company located at Cross Plains, Greenbrier, Barren Plains and Springfield.

BRITT, IOWA.—The Western Electric Telephone Company has acquired a controlling interest in the Hancock County Rural Telephone Company which is valued at $30,000, with exchanges at Garner, Britt and Kanawha and twelve or more toll stations located in as many towns. There are over 1,200 stations in the service which comprise the most of the telephones of Hancock and Wright counties. Z.

CONCORD, N. C.—The Concord Telephone Company has completed a seventy-mile connection with Greensboro, on the north, and now has connection with approximately 2,500 telephones located in Greensboro, High Point, Asheboro, and other towns in North Carolina. The company also operates a local exchange in Concord. Another line will be built shortly to Statesville, about forty-five miles distant, it is announced. L.

OMAHA, NEB.—The Independent Telephone Company has applied to the State Railway Commission for leave to extend its rates to South Omaha, Florence and other suburbs. A franchise given some time ago in South Omaha provided that until the number of subscribers exceeded 1,000, the service should be free. Attorney General Thompson holds that the franchise as to rates is void in that it deprives the railway commission of its power to establish telephone rates. He says the charter of South Omaha gives the city council no authority to make rates.

SHERMAN, TEX.—The reorganization of the Grayson County Telephone Company, which has been in progress for the past two years, has been completed and the property turned over to the new corporation, which in the future will be known as the Grayson Telephone Company. Announcement has been made that for the present the local management will remain the same as heretofore. The North Texas Telephone Company, with headquarters in this city, have also closed a deal for the Tioga telephone exchange and M. A. Evans of Van Alstyne has been placed in charge as manager.

NEW HAVEN, CONN.—The Southern New England Telephone Company is just completing a direct line for its toll wires connecting New Haven with Willimantic and Norwich. The line is as nearly a straight one as can be built and a great deal of labor has been expended in the preliminary work of surveying for it. The line runs through North Haven, North Branford, Durham, Higganum, Westchester and Colchester to Willimantic, and is a few miles north of a like air line of telegraph wires which were put through by the Western Union Telegraph Company a few years ago.

BUTTE, MONT.—With the purchase of the Big Blackfoot Telephone Company by the Montana Independent Telephone Company the Independent interests have acquired an extension of more than fifty miles to their system. The big Blackfoot Telephone Company, of which C. A. Jakways of Ovando was president, extends from Drummond to Ovando and Helmville and traverses a section through which the proposed new Milwaukee extension from Missoula to Great Falls is to be built. The newly-completed long-distance lines of the Montana Independent Telephone Company between Butte and Missoula will furnish a valuable connection for the Big Blackfoot Company.

DAYTON, O.—Claiming that their lines would be damaged by the high tension wires now being put up by the Ohio Electric Company, the managers of the Brookville, West Milton and New Lebanon Telephone Companies have filed a joint petition with the county commissioners asking that board to force the Ohio Electric to guard their interests. All three of the companies have lines that will be crossed by the 33,000-volt lines of the Ohio Electric Company. The commissioners granted the traction company permission to stretch their wires several months ago. They will make an investigation of this complaint on the part of the telephone interests.

ELECTRICAL SECURITIES.

The business done in the stock market during the past week was less than a quarter of that of the corresponding week of last year. The changes in price were small and unimportant. Railroad reports show an increase in business and in gross receipts but the higher rates in force are needed to meet the higher costs of operation.

DIVIDENDS.

Buffalo General Electric Company, quarterly dividend of one and one-half per cent on the common stock, payable September 30 to stock of record September 20.

Central Pennsylvania Traction Company, two per cent, payable October 1.

Chicago Telephone Company, quarterly dividend of two per cent, payable September 30.

Duluth Superior Traction Company, quarterly dividend of one and one-quarter per cent on the common stock, an increase of one-quarter of one per cent quarterly, and the regular quarterly dividend of one per cent on the preferred stock, both payable October 1 to stock of record September 15.

Interborough Rapid Transit, regular quarterly dividend of two and one-quarter per cent, payable October 1 to stock of record September 24.

Louisville Traction Company, quarterly common dividend of one per cent, and semiannual preferred dividend of two and one-half per cent, payable October 1.

Manila Electric Railroad and Lighting Corporation, regular quarterly dividend of one per cent, payable October 1 to stock of record September 19.

Old Colony Street Railway Company, quarterly dividend of one and three-quarters per cent, payable October 1.

Philadelphia Traction Company, semiannual dividend of $2 per share, payable October 1.

Standard Gas and Electric Company, an initial quarterly dividend of one and three-quarters per cent on its preferred stock, payable September 15 to holders of record August 31.

Stark Electric Railroad, quarterly dividend of three-quarters of one per cent, payable October 1.

Twin City Rapid Transit Company, quarterly common dividend of one and one-half per cent, and quarterly preferred dividend of one and three-quarters per cent, payable October 1.

Union Traction Company of Indianapolis, regular semi-annual dividend of two and one-half per cent on the preferred stock, payable October 1 to stock of record September 24.

United Traction and Electric Company, quarterly dividend of one and one-quarter per cent, payable October 1.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES IN THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.	Sept. 12	Sept. 5
Allis-Chalmers common	8	8
Allis-Chalmers preferred	30½	31
Amalgamated Copper	63¼	63½
American Tel. & Cable	*80	*80
American Tel. & Tel.	134½	134½
Brooklyn Rapid Transit	73½	74⅜
General Electric	140½	141¼
Interborough-Metropolitan common	17⅞	18⅜
Interborough-Metropolitan preferred	48¾	49⅜
Kings County Electric	122	121
Mackay Companies (Postal Telegraph and Cables) common	89¼	85
Mackay Companies (Postal Telegraph and Cables) preferred	73½	74½
Manhattan Elevated	129	129
Metropolitan Street Railway	*18	*18
New York & New Jersey Telephone	103	103
U. S. Steel common	68⅛	68¾
U. S. Steel preferred	116	116
Western Union	62	61
Westinghouse common	58½	57
Westinghouse preferred	*125	*125

*Last price quoted.

BOSTON.	Sept. 12	Sept. 5
American Tel. & Tel.	134½	134¾
Edison Elec. Illuminating	256	258
General Electric	140½	141¼
Massachusetts Electric common	17½	17½
Massachusetts Electric preferred	81	80
New England Telephone	130	129
Western Tel. & Tel. common	14½	14½
Western Tel. & Tel. preferred	83	83

PHILADELPHIA.	Sept. 12	Sept. 5
American Railways	43	44
Electric Company of America	11⅜	11¼
Electric Storage Battery common	47¼	46⅜
Electric Storage Battery preferred	47¼	46¾
Philadelphia Electric	15	15
Philadelphia Rapid Transit	18¼	17¼
Philadelphia Traction	84	83¾
Union Traction	43⅛	42½

CHICAGO.	Sept. 12	Sept. 5
Chicago Railways, Series 1	70	70
Chicago Railways, Series 2	16	16
Chicago Subway	4	4½
Chicago Telephone	117	117½
Commonwealth Edison	110	110
Metropolitan Elevated common	19	19
Metropolitan Elevated preferred	60	60
National Carbon common	118	118
National Carbon preferred	118¼	118¼

FOREIGN TRADE OPPORTUNITIES.

(From *Daily Consular and Trade Reports*, issued by the Bureau of Manufactures, Washington, D. C. In applying to the Bureau for addresses, refer to file number.)

No. 5458. ELECTRICAL AND WATERWORKS SUPPLIES.—An American consul in Mexico reports that a company in the United States, the name of which is on file at the Bureau of Manufactures, has been granted the franchise to install and operate electric light and water works systems in one of the cities. The town and federal authorities have contracted for water to be supplied to all schools, public buildings and parks, and many citizens have arranged for individual service. Arc lights are to be used for the streets, and incandescent lights for the interior of all public buildings. Contracts have been made for about 2,000 incandescent lights in private houses, and arrangements partially completed for using electric current for power purposes, such as driving irrigating pumps. The investment represents $75,000, all the capital being furnished by the company.

No. 5460. MOTOR BOATS.—An American consul in Canada forwards the name of a person in his district who wants a motor boat costing several thousand dollars, and suggests that interested American firms take the matter up at once.

No. 5461. WATERWORKS.—An American consul reports that a municipality in India has been granted leave to contract a loan of $259,520 for the purpose of extending the existing waterworks system. The water supply is to be brought a distance of 115 miles. Further details will be available in a short time.

No. 5465. MACHINE TOOLS AND ELECTRICAL CRANES.—An American consul in Oceania reports that a large firm in his district which represents certain American firms desires to get in touch with manufacturers of all classes of machine tools in the United States. This firm is also interested in electrical cranes, and has facilities for extending the trade in this line.

No. 5466. MACHINERY, ELECTRICAL APPLIANCES, AND RAILROAD EQUIPMENT.—A firm in Belgium informs the Bureau of Manufactures that it is engaged in establishing agencies throughout Europe, Asia Minor, and North Africa, and wants to represent American manufacturers of hardware, machinery, railroad equipment, and electrical appliances.

No. 5476. TELEPHONES FOR CHINA.—In answer to an inquiry from the United States, an American consul in China reports that a city with a population of about 55,000 has no telephone service. There are also a number of smaller places within a radius of twenty-five miles, also two cities of considerable importance which could easily be reached by outside lines. The consul thinks it doubtful if a concession could be secured, but forwards the name of the electric light company in that city which might be interested in the introduction of a telephone service.

No. 5481. ELECTRICAL COOKING APPARATUS.—A party in Mexico informs an American consul that he desires catalogues of electrical cooking apparatus suitable for use in a launch. The consul thinks that if the inquirer secures a suitable appliance others will adopt the idea. There are many launches and motor boats in the district, and the cooking apparatus would add to the comfort of trips lasting several days.

NEW INCORPORATIONS.

HAMMOND, IND.—The Interstate Construction Company has incorporated, capitalized at $30,000. The company proposes to make a specialty of constructing electric railroads. Frank O'Shea, John C. Lavernie and Iurace Shia are directors. S.

EVANSVILLE, IND.—The Jewett-White Electric Company has filed articles of incorporation with the Secretary of State. The corporation proposes to manufacture and sell electrical equipment and supplies of all kind. The capital stock is $10,000, which amount will be increased. C. S. Jewett, E. S. Wise and F. M. Hasstetter are directors. S.

LOUISVILLE, KY.—The Bland Electric Company has filed articles of incorporation in the County Clerk's office, with a capital stock of $3,000, divided into shares of $100 each. The company will deal in electrical supplies. The incorporators, all of whom hold three shares of stock each, are W. G. Osborne, J. Osborne Bland and John Jansen. The Urwick Machinery and Supply Company filed amended articles of incorporations reducing the capital stock from 500 to 150 shares, valued at $100 each. The articles as filed are signed by C. Urwick, Thomas D. Osborne and John Boyce Baskin.

PROPOSALS.

WIRING OFFICERS' QUARTERS.—The office of Constructing Quartermaster, Fort Hamilton, N. Y., will receive sealed bids until September 22, for the construction, including plumbing, heating, electric wiring and fixtures of one set of field officers' quarters and one six-set officers' quarters. Plans, specifications and full information can be obtained at the Constructing Quartermaster's office, Fort Hamilton, N. Y.

POST OFFICE, MALONE, N. Y.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until October 12, for the construction, complete (including plumbing,

gas piping, heating apparatus, electric conduits and wiring) of the United States post office at Malone, N. Y., in accordance with drawings and specifications, copies of which may be obtained from the custodian of site at Malone, N. Y., or at the Supervising Architect's office.

PERSONAL MENTION.

EDWARD J. KUNZE has been appointed assistant professor of mechanical engineering at the Michigan Agricultural College.

GEORGE W. PATTERSON, professor of electrical engineering at the University of Michigan, is now in Europe on a year's leave of absence.

ANTONIO GUELL, research fellow in the engineering experiment station of the University of Illinois, has entered the employ of the General Electric Company at Lynn, Mass.

J. B. KENYON lectured to the members of the Engineering Department of the National Electric Lamp Association, Cleveland, Ohio, on "Salesmanship" on the evening of September 6. The lecture was given in the large auditorium on the third floor of the Association's new engineering building.

ARTHUR FRITSCH was recently made manager of the Chicago office of Pawling & Harnischfeger, of Milwaukee, manufacturers of traveling cranes. Mr. Fritsch was formerly connected with the Allis-Chalmers Company and was, until quite recently, president of the Big Four lead and zinc mine at Platteville, Wis.

L. D. McLEAN, formerly general commercial superintendent of the Southwest Telegraph and Telephone Company with headquarters in Dallas, Tex., recently resigned. He is now commercial superintendent of the Interstate Consolidated, State Telephone & Telegraph Company and other Lane properties. Mr. McLean's headquarters are now at Butte, Mont.

A. S. GARFIELD, chief engineer of the French Thomson-Houston Company, has been awarded the cross of the Legion of Honor by the French Government. Mr. Garfield has been connected with the company for many years and occupies a prominent position in electrical affairs. He is one of the leading spirits in the development of electric traction in France.

E. F. NORTHRUP, formerly of the Leeds & Northrup Company, of Philadelphia, has accepted an appointment as assistant professor of physics at Princeton University, where he will make a specialty of physical and electrical measurements. Dr. Northrup has specialized in this subject and has conducted considerable research work, and a number of the new ingenious instruments and apparatus which have been brought out by the Leeds & Northrup Company are due to his efforts in this line.

W. P. HANCOCK, one of the department heads of the Edison Electric Illuminating Company, contributes to the current issue of *Edison Life*, the bright little monthly of the Boston Edison Company, a very readable account of his experiences in the early years of the development of the electrical industry. Mr. Hancock's rise in the electrical world is modestly told and his story displays no little literary ability. It will be read to the finish with the greatest interest, not only by the old-timers to whom he makes frequent reference, but also by the younger generation who will profit exceedingly by the many human touches which Mr. Hancock introduces in his vivid recital.

E. L. CLARK, president of the Valentine-Clark Company, Chicago, dealer in cedar poles, recently returned from an eight weeks' trip to Idaho, where he went to establish new yards for the company's Western cedar poles. These yards are located at St. Maries, Idaho, and are on the St. Joe River. Unexcelled shipping facilities and all other modern conveniences for handling poles are at the disposal of the company. Mr. Clark had a number of thrilling experiences on this trip as he and his family lived six weeks on a house boat on the St. Joe River, and were close to the tremendous fires which lasted five days and devastated so much property. At one time the Clark family was within a quarter of a mile of the nearest fire, and at no time was the fire more than five miles away.

OBITUARY.

SIR CHARLES EVAN SMITH, a director of the Marconi Wireless Telegraph Company, and at one time chairman, died recently in London.

HON. EDWARD L. PULLEY, formerly a state senator, and the general manager of the Huntsville Electric Railway Company, died at his home in Huntsville, Ala., September 7. Mr. Pulley was a lawyer by profession, and was one of the best known men in the Tennessee Valley.

JAMES HEYWOOD, superintendent of lines and cables of the Philadelphia Rapid Transit Company, died on July 31. He was born in England, but came to this country as a child, and in 1892 was graduated from the Central Manual Training School in Philadelphia. After some street-railway work in Baltimore, he took charge of the underground cable work for a Philadelphia traction company in 1893, and had been engaged in this work up to the time of his death. He invented a support for cables to be used in manholes, and other practical devices. He was an associate of the American Institute of Electrical Engineers and a member of the American Street and Interurban Railway Association.

INDUSTRIAL ITEMS.

THE RAIL JOINT COMPANY, New York, N. Y., announces the removal of its general offices to the Cameron Building at 185 Madison Avenue, New York City.

THE INDUSTRIAL INSTRUMENT COMPANY, Foxboro, Mass., recently issued Bulletin No. 38 on the subject of industrial recording gauges. A number of the features of these gauges are listed and a facsimile of a chart is shown.

THE ADVANCE ELECTRIC COMPANY, St. Louis, Mo., recently distributed Bulletin No. 4, describing single-phase alternating-current motors. In the repulsion motors which are illustrated in this bulletin the aim was to combine the best features of the commutator type and the squirrel-cage type.

THE HARTFORD TIME SWITCH COMPANY, New York, N. Y., has issued salesman sheets No. 1, No. 2 and No. 3 and a folder describing the Hartford automatic time switch. This is a device by which current is automatically turned on and off at such times as the user desires, with no further attention than the weekly winding.

THE WHEELER CONDENSER AND ENGINEERING COMPANY, Carteret, N. J., recently issued a pamphlet entitled "Condensers for Small Central Stations," in which is reprinted a lecture delivered before the Missouri Gas, Electric and Street Railway Association. It contains a number of useful tables, charts and curves relating to the operation and economy of condensing machinery.

PETTINGELL-ANDREWS COMPANY, Boston, Mass., begins with the September issue of *Juice* a new policy regarding the publication of that periodical. Each issue will, in the future, be devoted to special departments of the business. Beginning this policy the September number has been designated as the Fixture Number and contains an article illustrated by views of the company's fixture studios. The article closes with a list of well-known installations.

THE CUTTER COMPANY, Philadelphia, Pa., has prepared an advertising calendar for the twelve months beginning with September, 1910. Each one of the pages of this calendar shows one of the forms of the Cutter Company's well known I-T-E apparatus. In connection with the illustrations are descriptions of the forms of circuit-breaker and some information regarding the use to which each is adapted. The motor-operated I-T-E laminated circuit-breaker which is described has a current-carrying capacity of 10,000 amperes.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., calls attention in a recent folder to the fact that it has stock switchboards ready for immediate shipment. Some types of these boards are illustrated and described therein. A novel feature of this folder is an insert consisting of a Postal Telegraph-Cable Company's night lettergram and a Western Union night letter. For the customer's convenience he is instructed to write his order on one of these and send it at the company's expense.

DATES AHEAD.

Pacific Coast Electrical Exposition. San Francisco, Cal., September 17-24.

American Mining Congress. Thirteenth annual session, Los Angeles, Cal., September 26 to October 1.

Colorado Electric Light, Power and Railway Association. Next convention, Glenwood Springs, Colo., September 21, 22 and 23.

Central Electric Railway Association. First meeting, Indianapolis, Ind., September 22.

Kansas Gas, Water, Electric Light and Street Railway Association. Annual meeting, Kansas City, Kan., September 27 and 28.

Association of Railway Electrical Engineers. Annual convention, Chicago, Ill., September 27-30.

Vermont Electrical Association. Annual meeting, Brandon, Vt., September 28 and 29.

Denver Electric Show. Colorado Electric Club, Denver, Colo., October 8-15.

American Street and Interurban Railway Association. Annual convention, Atlantic City, N. J., October 10-14.

American Society of Municipal Improvements. Annual convention, Erie, Pa., October 11-14.

Western Association of Electrical Inspectors. Sixth annual meeting, Omaha, Neb., October 11, 12 and 13.

Railway Signal Association. Annual meeting, Richmond, Va., October 12-15.

American Electrochemical Society. Eighteenth general meeting, Chicago, Ill., October 13-15.

Order of the Rejuvenated Sons of Jove. Eighth annual meeting, Birmingham, Ala., October 13-15.

American Iron and Steel Institute. First meeting, New York City, October 14 and 15.

Illuminating Engineering Society. Annual convention, Baltimore, Md., October 24-25.

American Association of Electric Motor Manufacturers. Semi-annual meeting, Chicago, November 14-16.

Alabama Light and Traction Association. Next meeting, Anniston, Ala., November 21-23.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) September 6, 1910.

969,161. DYNAMO. Louis Anthyme Herdt, Montreal, Quebec, Canada, assignor of one-half to Julien Dalemont, Montreal, Canada. Filed Dec. 19, 1908. In combination with a three-phase alternator, with exciting coils on its magnet cores and means maintaining a direct current in such exciting coils, are means generating no-load electromotive-force proportional to the electromotive-force of the alternator when the alternator is carrying no load, and means automatically varying the exciting current proportionally to the load current and the angle between the load current and the no-load electromotive force of the alternator.

969,193. GOVERNOR. Walter Joseph Richards, Milwaukee, Wis., assignor to National Brake & Electric Company, Milwaukee, Wis. Filed April 26, 1909. A governor for air pumps and the like, comprises a casing, a dished plate secured to the casing, a plunger head working within the recess of the dished plate and provided with lugs projecting through openings in the dished plate, a pressure-flexed diaphragm bearing on the plunger head, a spring-pressed plate within the casing bearing on the ends of the lugs of the plunger head and a movable circuit controller having connection with the plunger head to be operated thereby.

969,211. SHADE-HOLDER. Theodore Smith, Chicago, Ill. Filed Jan. 2, 1909. A shade-supporting ring has clamping jaws which are provided with shoulders for engagement with the bead of an ordinary lamp socket; a ring has cams for engagement with the jaws; and locking means are provided for locking the ring against movement upon the jaws.

969,265. ELECTRIC-CONTROLLER PLUG. Benjamin Fulton Gardner, Chicago, Ill. Filed July 16, 1909. An electric controller plug comprises a metallic screw-threaded shell containing nonfusible electric resistance material, a movable metal part in direct contact with this material, suitable insulating material between the screw shell and the nonfusible resistance material, and suitable insulating material between the movable metal part and the screw shell.

969,281. APPARATUS FOR OPERATING RAILWAY SIGNALS. Winthrop K. Howe, Buffalo, N. Y., assignor to General Railway Signal Company, Buffalo, N. Y. Filed Oct. 11, 1906. In combination with a source of energy are: a motor, a signal; its operating mechanism and mechanism driven by the motor; a slot magnet and a stop mechanism for holding the motor-driven mechanism against vibration when the signal reaches the proceed position comprising a rear stop for absolutely preventing the movement of the signal toward normal, a front stop for overcoming the momentum of the signal when it reaches the proceed position and means for moving the stops into action when the slot magnet is energized and out of action when the slot magnet is de-energized.

969,283. ELECTROLIER-FIXTURE. Harold F. Hutchinson, Rochester, N. Y. Filed June 16, 1909. A drop-light fixture for electric lamps comprises a fixture pipe, fixed supports, movable means mounted on the fixed supports and operatively connected to, but removable from, the pipe for receiving a cable by which the fixture may be raised and lowered.

969,327. ELECTRIC IGNITION DEVICE FOR INTERNAL-COMBUSTION ENGINES. Henry Batt, Hendersyde Park, Kelso, Scotland. Filed March 25, 1910. A driving couple for high-tension magnetos.

969,336. LIGHTNING-ARRESTER. Fabius M. Butler, David City, Neb. Filed Jan. 21, 1910. A lightning-arrester comprises a receptacle having chambers or cavities separated by a wall of less height than the depth of the cavities (the cavities each containing mercury), and circuit terminals entering the cavities into electrical contact with the mercury.

969,339. DEVICE FOR CUTTING INSULATION FROM CONDUCTORS. Emil F. Chytraus, Yonkers, N. Y., assignor to Otis Elevator Company, Jersey City, N. J. Filed Dec. 20, 1907. A handled carrier has a transverse passage for the insertion of insulated wire, two cutters, one for cutting the insulation circumferentially and the other for cutting the same longitudinally, and separate devices for operating the cutters.

969,345. SYSTEM OF ELECTRICAL DISTRIBUTION. Frank S. Culver, Madison, Wis. Filed June 9, 1909. A form of cut-in is described.

969,349. PRIMARY BATTERY. Eben G. Dodge, Maplewood, N. J., assignor to Edison Manufacturing Company, West Orange, N. J. Filed June 12, 1909. A voltaic battery comprises a negative electrode plate, a positive electrode plate, insulating means separating the plates, means securing the parts together, the positive plate being so formed as to protect the part thereof contacted by the securing means against electrolytic action.

969,361. CIRCUIT-PROTECTING APPARATUS. John E. Graybill, York, Pa. Filed Sept. 15, 1906. In combination with a block of insulating material having a fuse recess formed therein, is a fuse terminal at each end of the recess having a seat for a fuse provided with resilient side and end walls, the latter being connected with the body of the terminal at points between the side walls.

969,387. GRID FOR STORAGE BATTERIES. Francis M. Michael, Eaton, Ohio. Filed April 1, 1910. A double grid is described, each grid being the shape of a basket formed of a network of hollow wires interwoven together. Each of the wires has a central conducting wire extending through the tube, and accumulated at one end of each grid, and connecting two grids together. A lead-paste compound fills each grid and forms a coating for the same, and a channel tube provided with depending ends incloses bunched wires connecting the two grids, the wires being soldered together, and the tube being filled with an alloy of lead.

969,393. COMBINED TELEPHONE AND PROTECTIVE ALARM SYSTEM. James G. Nolen, Chicago, Ill., assignor to John E. Shepherd, Chicago, Ill. Filed May 9, 1907. A combined telephone and burglar-alarm system.

969,403. HOLDER FOR TELEPHONE-RECEIVERS. Cornelius R. Phillips, Philadelphia, Pa., assignor of one-half to J. Cook and one-half to Jerome B. Felheimer, Philadelphia, Pa. Filed Oct. 9, 1909. A bracket-arm device.

969,409. HIGH-VOLTAGE RECEPTACLE AND PLUG. Frank J. Russell, Brooklyn, N. Y. Filed July 21, 1909. A receptacle member has a plug-receiving socket and a wall of insulating material arranged within the socket between the receptacle contacts and is provided at one end with a groove forming an insulating air gap.

969,414. ALARM SIGNALING SYSTEM. John E. Shepherd, Chicago, Ill. Filed Jan. 13, 1908. In a duplex heat-responsive alarm system, there are two independent heat-detecting elements each comprising piping containing fluid and indicating means responsive to change in pressure of the fluid within the piping due to the action of fire upon the piping, and a single signal transmitter operatively associated with the indicating means to transmit a signal of one character if either such indicator alone be actuated, and a different character of signal if both be actuated.

969,472. DYNAMO-ELECTRIC MACHINE. Fred C. Hall, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. Filed Dec. 14, 1908. A rotatable member for double-current machines comprising a core member, a supporting spider having a plurality of laterally projecting arms, a commutator cylinder and a plurality of concentric collector rings supported on the arms.

969,480. ELECTRIC SWITCHING APPARATUS. Samuel T. Hutton, Chicago, Ill., assignor to Sheidel Western X-Ray Coil Company, Chicago, Ill. Filed Feb. 13, 1909. A rotative drum device.

969,492. INSULATED PIPE-COUPLING. Sarah E. Peeples, Washington, D. C. Filed April 14, 1909. The device described comprises coupling members, insulation therebetween, and upwardly extending means located within one of the coupling members entirely above the insulation for preventing water of condensation or luting from coming into contact with the insulation.

969,493. ELECTROMAGNETIC MECHANISM. Henry Pierson, Manchester, England, assignor to Westinghouse Electric & Manufacturing Company. Filed Oct. 3, 1906. In combination with a frame or yoke different parts of which are provided with magnetizing conductors that are independently energized and have different magnetic circuits, is a movable armature having an unsymmetrical relation to the magnetic circuits; a yielding restraining means holds the armature in a given position when the magnetizing currents are normal in amount and direction and is overcome when one of the currents becomes abnormal in direction or excessively abnormal in amount.

969,498. PROTECTIVE MEANS FOR ELECTRICAL CIRCUITS. Charles F. Scott, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. Filed July 9, 1906. In combination with conductors for alternating currents and another circuit conductor disposed in proximity thereto, is a transformer having primary windings in circuit, respectively,

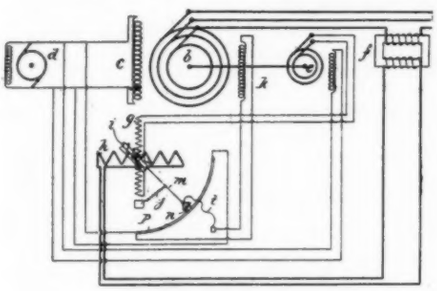
with the alternating-current conductors, and a secondary winding in circuit with the other conductor.

969,499. MEANS FOR NEUTRALIZING INDUCED DISTURBANCES IN INTELLIGENCE-TRANSMISSION CIRCUITS. Charles F. Scott, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. Filed July 9, 1906. In combination with two electrical circuits that are located within a magnetic field, is a transformer having a primary winding located in one of the circuits and a secondary winding in the other with a variable ohmic resistance connected in shunt to the primary winding, and a variable inductive resistance connected in series therewith.

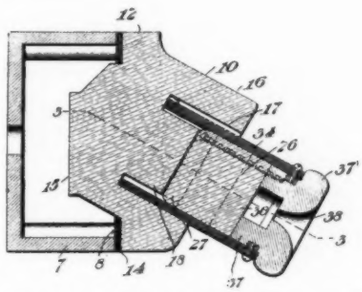
969,509. CONTROLLER FOR ELECTRIC MOTORS. Robert Friederich Baerlocker, Manchester, England, assignor to Westinghouse Electric and Manufacturing Company. Filed Dec. 24, 1909. A receptacle comprising a body portion and a removable cover, has a controller suspended from the cover and a circuit making and breaking switch, the respective members of which are supported by the body portion and by the cover.

969,510. SELF-REGULATING ARC-LAMP. Malcolm H. Baker, New York, N. Y., assignor to Westinghouse Electric and Manufacturing Company. Filed Aug. 1, 1903. In combination with a pair of cylindrical electrodes, located the one within the other, is an igniter located at a point remote from the arcing ends of the electrodes.

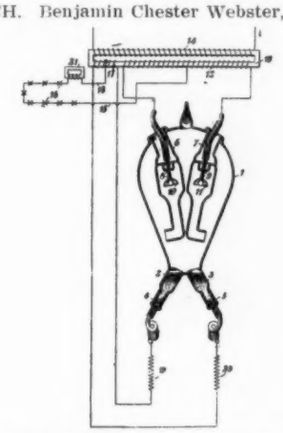
969,512. DRY CELL. Amos N. Barron, Cleveland, and Walter G. Wiatt, Fremont, Ohio, assignors to National Carbon Company, Cleveland, Ohio. Filed March 26, 1910. A dry cell comprises a zinc cup having a bibulous lining, a carbon electrode, and battery mix tightly packed in the lined cell around the electrode, a disk which embraces the electrode and fits within the cup, the disk being made of double-faced corrugated strawboard, and a seal in the cup on top of this disk.



969,161.—DYNAMO.



969,409.—HIGH-VOLTAGE RECEPTACLE AND PLUG.



969,525.—MERCURY VAPOR RECTIFIER.

969,513. CONTROLLER FOR ELECTRIC MOTORS. Howard L. Beach, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. Filed Feb. 10, 1909. A controller for electric motors comprises a rotatable and longitudinally adjustable shaft, a drum switch rotatably mounted thereon, a second drum switch secured to the shaft, and interlocking means between the two switches for preventing the adjustment of one except when the other occupies a predetermined position.

969,515. ELECTRICAL CONTROLLER. Carl E. Bedell, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. Filed Jan. 5, 1907. A controller comprises co-operating switch members, one of which is both rotatable and axially adjustable to cause variations in the circuit arrangements, and a single lever for effecting both adjustments.

969,523. AUTOMATIC STARTING DEVICE FOR MERCURY-VAPOR RECTIFIERS. Frederick S. Chapman, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. Filed Oct. 5, 1907. In combination with a mercury-vapor rectifier are means for overcoming the initial high resistance thereof, and a governing switch for this means, a switch for connecting either an auxiliary direct-current circuit or a load to the rectifier, and a device for operating the switches comprising two windings both of which are energized when the auxiliary circuit is connected to the rectifier and only one of which is energized when the load is connected to the rectifier to maintain the connection.

969,525. MERCURY-VAPOR RECTIFER. Frank Conrad, Swissvale, Pa., assignor to Westinghouse Electric & Manufacturing Company. Filed Sept. 20, 1906. In combination with a current-rectifying device having two positive and two negative terminals, are transformer windings connected, respectively, between the pairs of positive and negative terminals and having intermediate points connected, respectively, to a distributing circuit.

969,526. ELECTRICALLY-OPERATED TRACK-SWITCH. Fred B. Corey, Schenectady, N. Y., assignor to General Electric Company. Filed Dec. 24, 1908. A rotary electric motor is geared to a track switch. Two sets of contacts in circuit with the motor are arranged to be alternately opened in the two extreme positions of the track switch. Electromagnetically actuated contacts, selectively controllable by an approaching car, establish a circuit to either set of contacts. Connections are adapted to form maintaining circuits for the actuating windings of the electromagnetically actuated contacts, the maintaining circuits being arranged to be broken by the contacts controlled by the track switch.

969,527. PRINTING-TELEGRAPH. Albert C. Crehore, Yonkers, N. Y., assignor to Typewriting Telegraph Company, New York, N. Y. Filed Aug. 15, 1904. A telegraph system comprises receiving magnets, a series of relays less in number than the magnets being controlled by a fractional group of relays, and each of the respective groups containing the same number of relays, two line wires, each containing a number of the relays and means for individually operating the relays from a distant station by currents of distinctive values and distinctive polarities.

969,542. APPARATUS FOR CHARGING STORAGE BATTERIES. Alvaro S. Kotz, Springfield, Ohio, assignor of one-half to Paul A. Staley, Springfield, Ohio. Filed Jan. 12, 1905. In an apparatus for charging storage batteries, are means controlled by the variation of the potential of the battery in charging to successively change the rate of charging and to automatically discontinue the charging when the battery has reached its normal charged potential.

969,581. ELECTRIC SWITCH. Benjamin Chester Webster, Bridgeport, Conn. Filed May 20, 1909. In combination with a revoluble shaft, is a disk journaled loosely thereupon; a spring is connected with the disk; a commutator is mounted losely upon the shaft and connected with the spring; and means controllable at will are provided for adjusting the tension of the spring.

969,583. SYSTEM OF MOTOR CONTROL. Harold E. White, Schenectady, N. Y., assignor to General Electric Company. Filed May 18, 1908. A control system for a series of electrically controlled switches, etc.

969,584. CONTROL OF ELECTRICALLY-OPERATED SWITCHES. Harold E. White, Schenectady, N. Y., assignor to General Electric Company. Filed Feb. 27, 1909. A plurality of contactors are intended for operation in succession to effect certain connections in a power circuit; a plurality of auxiliary switches are arranged each to control a contactor; and electromagnets energized from the power circuit are arranged each to control the closing and opening of an auxiliary switch, whereby successive closing and opening of the contactors takes place under the control of the conditions in the power circuit.

969,585. CONTROL OF ELECTRICALLY-OPERATED SWITCHES. Harold E. White and Eugene R. Carichoff, Schenectady, N. Y., assignors to General Electric Company. Filed Feb. 27, 1909. Similar to the preceding.

969,599. INSULATION-APPLYING DEVICE. Joseph A. Cates, Mason, Tex. Filed March 1, 1910. The implement described comprises a two-part spindle, mountable and slidable on an endless wire, an insulation carrier on one of the spindle parts, a frame mounted on the spindle and means on the frame for rotating the spindle and the carrier to wind the insulation on the wire.

969,607. CIRCUIT-CONTROLLER. Kenneth L. Curtis, Boston, Mass., assignor to Albert and J. M. Anderson Manufacturing Company, Boston, Mass. Filed May 4, 1910. A circuit controller comprises a pivoted contact member, stationary contact members located on opposite sides of the pivot of the member and with which the member co-operates, a stop interposed between the pivot

for the movable member and one set of the stationary contact members and normally in the path of the movement of the pivoted contact member into engagement with the second set of contact members for moving the stop laterally to permit the pivoted contact member to be engaged with the first mentioned set of contact members.

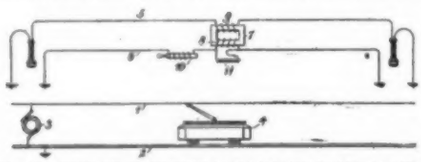
969,608. DYNAMO-ELECTRIC MACHINE. Joseph Le Conte Davis, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. Filed Dec. 14, 1908. Describes a frame of special design.

969,617. KEY-SOCKET FOR ELECTRIC INCANDESCENT LAMPS. Gilbert W. Goodridge, Bridgeport, Conn., assignor to The Bryant Electric Company, Bridgeport, Conn. Filed Oct. 2, 1908. An electric lamp key socket has an insulating body with a well to receive the switch mechanism, a screw shell forming one of the lamp terminals, mounted on the insulating body, at the mouth of the well, and a central contact plate projecting across the mouth of the well back of the screw shell in combination with co-operating switch mechanism, carried by the contact plate.

969,622. ELECTRIC FURNACE. James E. Hewes, Plattsburg, N. Y. Filed Sept. 7, 1905. An electric furnace comprises a sectional trough-shaped hearth, means to feed the hearth in the direction of its length, two electrodes directed toward each other over the hearth, hollow water-jackets supporting the electrodes and arranged upon opposite sides of the furnace, and means for simultaneously moving the water jackets to or from each other.

969,633. MACHINE FOR GRINDING COMMUTATORS OF DYNAMOS AND MOTORS. William H. Jordan, New York, N. Y., assignor to Jordan Brothers, New York, N. Y. Filed Sept. 2, 1908. The machine has a shaft, means for supporting the shaft in parallelism with the shaft of the electrical machine, an arm on the shaft, a grinding wheel on the arm, and a worm gear for twisting the shaft and regulating the depth of cut of the wheel.

969,646. ELECTRICAL SWITCHING DEVICE. James G. Meredith,



969,499.—APPARATUS FOR NEUTRALIZING INDUCED DISTURBANCES.

Lynchburg, Va. Filed June 7, 1910. The switch includes a plurality of magnets, a source of current, a series of movable contacts less in number than the number of magnets, and means through any of the movable contacts desired.

969,676. TELEPHONE-LINE-WIRE DETACHER. John K. Tomlinson, Pickaway, W. Va., assignor of one-third to W. W. Rittenhouse, Ronceverte, W. Va. Filed Dec. 29, 1909. A wire detacher comprises two terminal members one of which is movable into and out of axial housed relation to the other, a lock carried by one terminal for holding the terminals in electric connection, and a single means for moving the lock to the unlocked position and restoring the terminal members to the locked position.

969,712. METHOD OF MAKING ARMORED ELECTRICAL CONDUCTORS. George A. Lutz, Plainfield, N. J., assignor to American Circular Loom Company, Portland, Me. Filed March 23, 1909. The method consists in inclosing a conductor within a spirally wound cover of greater internal diameter than the conductor, and compressing and reducing the diameter of the cover around the conductor.

969,723. PUSH-BUTTON SWITCH. Clarence D. Platt, Bridgeport, Conn. Filed June 14, 1909. The switch comprises a shaft, an oscillating blade carrier mounted on the shaft, a spring for throwing the blade carrier to either extreme of its movement, a pivotally mounted latch provided with a single projection for locking the blade carrier in either extreme of its movement, the latch being provided with an opening for the passage of the shaft, and means for reciprocating the latch.

969,737. PERFORATING OR PUNCHING MACHINE. Joseph Weber, Liberty, N. Y., assignor to Wilmot L. Morehouse, Brooklyn, N. Y. Filed Aug. 10, 1909. The device includes a punch, a rod carrying the punch, a spring-controlled rod engaging the first rod, a shaft, means for electrically actuating the shaft including magnets and an armature engaged by the magnets (the armature engaging the last-named rod), and means for feeding a strip of paper under the punch.

969,738. CONTROL OF ELECTRICALLY-OPERATED SWITCHES. Harold E. White, Schenectady, N. Y., assignor to General Electric Company. Filed Feb. 27, 1909. A plurality of contactors operate in succession to effect certain connections in a power circuit; a plurality of auxiliary switches are arranged each to control the operation of a contactor; a plurality of electromagnets co-operate each with an auxiliary switch; and connections are provided whereby a contactor in closing decreases the number of effective turns in the electromagnet of its co-operating auxiliary switch.

969,754. TROLLEY-SHIFTER. Samuel L. Hanson, Albert Lea, Minn. Filed June 4, 1910. In combination with a flexible track section, and a rigid track section arranged parallel therewith, is a trolley-shifting device comprising a base plate adapted to be secured to the rigid track section and provided on its under side with means for securing the flexible track section, and provided on its upper side with a trolley-guiding rib adapted to fit against the end of the rigid track section at one end and having its other end beveled to merge into the surface of the flexible track section.

969,759. ELECTRICAL RELAY. Edward E. Clement, Washington, D. C., assignor to The North Electric Company, Cleveland, Ohio. Filed Sept. 10, 1906. An electrical relay comprises an electromagnet, a return bar carried by the core of the magnet, and extending to a point approximately flush with the front end of the core, circuit-changing devices, an armature supported on the bar and an operating connection from the circuit-changing devices through the bar to the armature.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired September 12, 1910:

504,732. PRINTING-TELEGRAPH. Samuel R. Linville, Philadelphia, Pa.

504,738. ELECTRIC SWITCHBOARD. Frederick W. Mount, St. John, Canada.

504,740. PORTABLE STATIC ELECTRIC MACHINE. Theodorus H. Patee, Chicago, Ill.

504,741. ELECTRIC DOOR REGISTER FOR WATCHMEN. William R. Patterson, Chicago, Ill.

504,743. SOCKET FOR INCANDESCENT ELECTRIC LAMPS. Charles G. Perkins, Hartford, Conn.

504,745. ELECTRIC SIGNAL DEVICE. Charles R. Piggins, Racine, Wis.

504,746. GALVANIC DRY BATTERY. John Von Der Poppenburg, Charlottenburg, Germany.

504,751. ELECTRICAL TESTING APPARATUS. Charles H. Rudd, Evanston, Ill.

504,752. ELECTRIC SIGNAL DEVICE. Charles H. Rudd, Evanston, Ill.

504,753. ELECTRICAL TESTING APPARATUS. Charles H. Rudd, Evanston, Ill.

504,754. ELECTRIC MEASURING APPARATUS. Charles H. Rudd, Evanston, Ill.

504,760. ELECTRIC ARC LAMP. Charles T. Snedekor, Worcester, Mass.

504,801. TELEPHONE TRANSMITTER. James A. Brown, Moline, Ill.

504,815. CARBON FOR ELECTRIC-ARC LAMPS. Robert McManus, Brooklyn, N. Y.

504,827. ELECTRO-MECHANICAL GONG. Franklin M. Dunn, Baltimore, Md.

504,845. CARBON FOR ELECTRIC ARC LAMPS. Robert McManus, New York, N. Y.

504,847. CONDUIT ELECTRIC RAILWAY. Henry D. Oler, Paterson, N. J.

504,866. ELECTRIC-LIGHT FIXTURE. Frank W. Davenport, Providence, R. I.

504,914. DYNAMO ELECTRIC MACHINE. Rolfe Eldredge, New York, N. Y.

504,938. ELECTRIC CUT-OUT. Herbert N. Prentice, Stowmarket, Eng.

504,977. SUPPLY SYSTEM FOR ELECTRIC RAILWAYS. George F. Green, Kalamazoo, Mich.

504,980. ELECTRICAL ALARM SYSTEM. Charles K. Hall and William B. Lillard, New Orleans, La.

505,032. AUTOMATIC SAFETY-JOINT FOR ELECTRIC CONDUCTORS. James H. Curry, Wilkinsburg, Pa.

505,051. ELECTRIC-ARC LAMP. William B. Luce, Brookline, Mass.

505,060. PORTABLE ELECTRIC-LAMP SUPPORT. Norman T. Mills, Boston, Mass.

505,062. ELECTRIC TIME-RECORDER. Charles E. Ongley, New York, N. Y.

505,063. SWITCH FOR GOVERNING ELECTRIC MOTORS. Edgar F. Ramien, Milwaukee, Wis.

505,064. SWITCH FOR CONTROLLING ELECTRIC MOTORS. Harry Sawyer, Muskegon, Mich.

505,070. TELEPHONE SWITCH. Josef Steiner, Brooklyn, N. Y.

505,081. CONDUIT ELECTRIC RAILWAY. Charles O. Ehlert, New York, N. Y.